BRINGING ECONOMIES OF SCALE IN MEGA CONTAINERSHIPS TO PORTS

Arduino, Giulia

Dipartimento di Economia e Metodi Quantitativi, Università degli Studi di Genova, Italy, T +39(0)102095204, F +39(0)102095511, e-mail: arduino@economia.unige.it

Carrillo Murillo, David Guillermo

Institut für Wirtschaftspolitik und Wirtschaftsforschung, Universität Karslruhe (TH), Germany, T +49(0)721 608-3076, F +49(0)721 608-8923, e-mail: david.carrillo@iww.uni-karlsruhe.de

ABSTRACT

The growth in freight transportation during the last decade has been linked with the economic advantages of allocating production in Far East sites with cheap hand labour. Therefore, a trend of using more and more containers has been observed in transportation and just about everything we see or set on our hand on spent time in a container. In fact, more than sixty percent of global trade in value travels in containers. As a consequence, the concentration of freight flows through containerisation has become an important issue for shipping liners. One of their reactions consisted in the strategy to employ mega containerships capable of carrying more than eleven thousand containers on the routes to the Far East. As a result, a new segment of the container market has been launched by Maersk Line, the first shipping company pioneer of these practices with the construction of mega vessels of these dimensions in 2006. A question rises on the convenience to participate to this segment of market on the overcoming years.

The present paper aims to understand the economic interests of Port Authorities in accommodating this type of new ships, and to investigate the potential growth of this new market. Consequently, a twofold analysis has been developed. First, an overview of the market including global container operators, current and future fleet and the analysis of the main routes operated until now. Second, the economic benefits that this new market brings to Port Authorities have been calculated for two ports. Results will show the port fees per container and the total revenues for a Port Authority as well as the share of these revenues that contributes for the return of capital invested. Finally, main conclusions are focused on possible expectations and on recommendations for Port Authorities considering investments on the arrival of such vessels.

Keywords: container, post-panamax, Port Authority, port tariff, port cost, mega container vessel, containerisation

1 INTRODUCTION

Mega containerships are highly risk to manage and they may lead to several losses for the insurance companies. In this moment of economic crisis they may represent sunk cost for the ship-owners. Even for the terminal operators and for the port administrators the investments required for these vessels represent a high risk too. However, if one takes the risk in investing on this kind of vessels, the earnings could be highly profitable even at economic crisis periods for all, maritime and logistics actors.

In an environment of such economic depression, only two shipping liners have dared to launch the new market of shipping container in mass. However, one liner is already operating on the European-Far East market while the second one is currently focusing its assets to the Asian economy. Fostered by means of consolidation and economies of scale, the capacities of these vessels have already overtaken the barrier of the unimaginable. Just for having an idea of the dimensions of these vessels, take in mind that a port should use more than ten post-panamax cranes for handling their total cargo in a maximum of two days, because the economic rule of thumb is to keep these ships always sailing.

In literature, these ships are classified as Ultra-large, Very-large or even Mega container vessels with an unclear definition of the range in capacity, dead weight tonnage or dimensions. For the purpose of this paper the term of mega container vessels will refer to the largest vessels yielding with more than twelve thousand containers or twenty-foot equivalent unit (TEU). However, the investigation is extended to those vessels of more than eight thousand TEU in capacity to consider the actual situation of the market of containers and to observe at the trend and at the strategies of the maritime stakeholders.

The main objective of this study is to understand how these vessels turn away the economic barriers for generating such earnings that justify their utilisation. Of course the risk and the strategies of the terminal operators and shipping liners play an important role but, what about the incentives of the port administrators, how they can justify the huge investments required for infra- and supra-structure and how the new evolving market could be pictured. The answers to these questions are developed on the core of the present study and are summarised in the corresponding conclusions.

For a better understanding of the investigation behind the world of mega container vessels, this paper has been divided into four chapters. An overview of the trend of vessel size and the global fleet analysis considering their routes and the stakeholders' strategies are included in section two. The third section provides two real case examples focusing on the revenues that a port receives for accommodating these mega vessels. Finally, in section four the conclusions are drawn on the complete analysis, the strategies and pressures that the new era of mega vessels is triggering over the maritime market of containers.

2 MEGA CONTAINERSHIPS' MARKET

The market of containers has always lead to different solutions according to the size of flows. As soon as those flows were increasing, new solutions appeared in the market. In order to analyse the premises of mega containerships, a study has been developed on the actual position of maritime companies, the changes in their fleet, the risks and the technical requirements that a market of this type of vessels involves.

2.1 Historical vessel size.

In the history of containerisation, one of the most relevant trends shaping the deep-sea trades has been the growth in the vessel size since 1956. In particular, the average ship size increased steadily over time, while the maximum size grew only from time to time. The market generally needs some years to improve the new size in relation to the volatility of the demand and freight rate fluctuations.

The market of container vessels has been continuously growing from the early 1980's, as shown in Fig. 2.1. In 1985, a trend of gradual increase led to the 4 000 twenty-foot equivalent unit (TEU) Panamax vessels ordered in the early 1990's. After the mid-1990's, an untypical rapid growth in size took place, as a consequence of the post-Panamax concept (pioneered by American President Lines Ltd. (APL) in 1989), as long as more than 7 000 TEU ships appeared on the market.

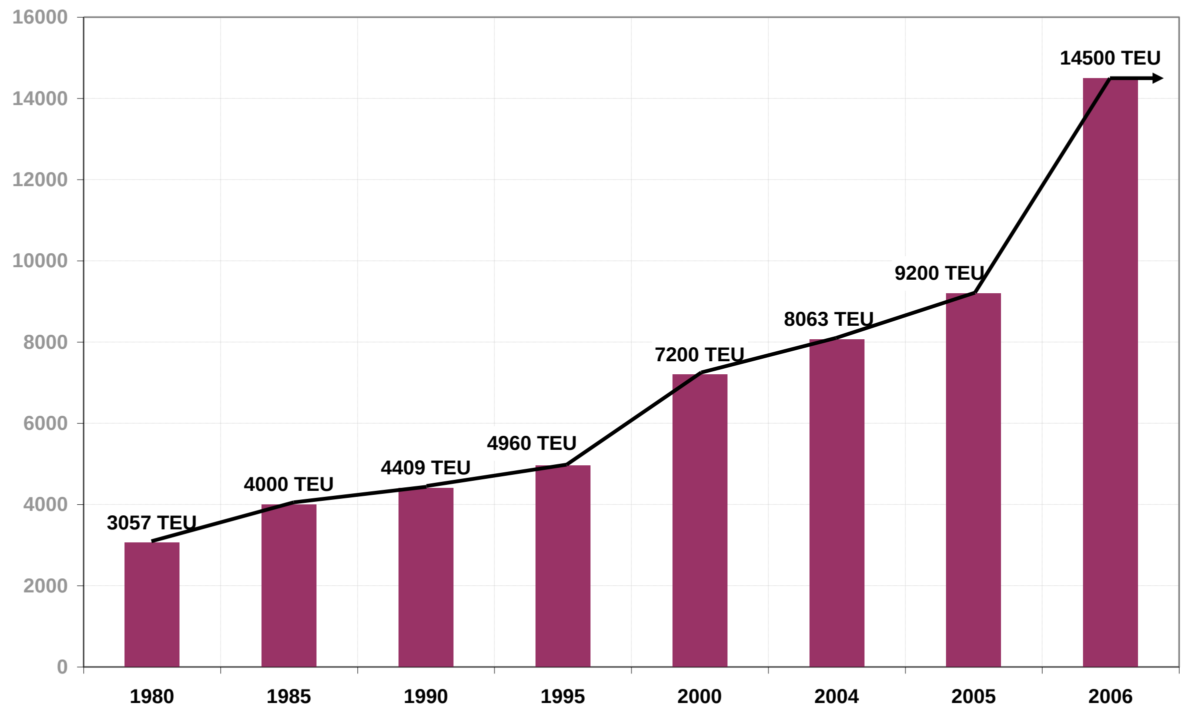

***Figure 2.1** – Evolution of the largest containerships*

Source: Authors' own elaboration with data of Woodbridge et al. (2008) and Stenvert and Penfold (2007)

In recent years, the major shipping lines have employed ships over 8 000 TEU with a speed of 24/25 knots. From 2005 to 2006, there was a strong increase in size due to the construction of Emma Maersk, the largest in service since 2006, with the maximum capacity of 14 500 TEU. Its official capacity is 11 000 TEU according to the calculation on the basis of 80 percent cargo load per container. Since then, the market has observed vessels with less or equal capacity like the other seven vessels with the same characteristics as the Emma Maersk (Maerskline, 2008). According to a recent study (Stenvert and Penfold, 2007), 12 500 TEU and 14 500 TEU vessels - defined by them as Ultra large containerships - would have become a dominant tool for long-haul trades in 2008. This did not happen in reality, as mega containerships still represent a niche market.

2.2 Fleet analysis

The current fleet composition of the top ten global shipping companies shows that the proportion of mega vessels is quite low if compared to that of ships with less than 8 000 TEU capacity, as evidenced in fig. 2.2. This is done by the early promises of the future mega container vessels, since it is a relatively young market whose high investment represents a high risk. Today, most of global carriers' fleets include mega vessels of the 8 000 - 10 000 range. Only four shipping lines - Maersk Line, Mediterranean Shipping Company (MSC), Compagnie Maritime d'Affrètement - Compagnie Générale Maritime (CMA-CGM) and China Ocean Shipping Container lines (COSCON) - have containerships over 10 000 in their fleet. The highest percentage of these mega vessels belongs to Maersk Line and MSC, the unique two liners owning vessels with a maximum capacity beyond 12 000 TEU.

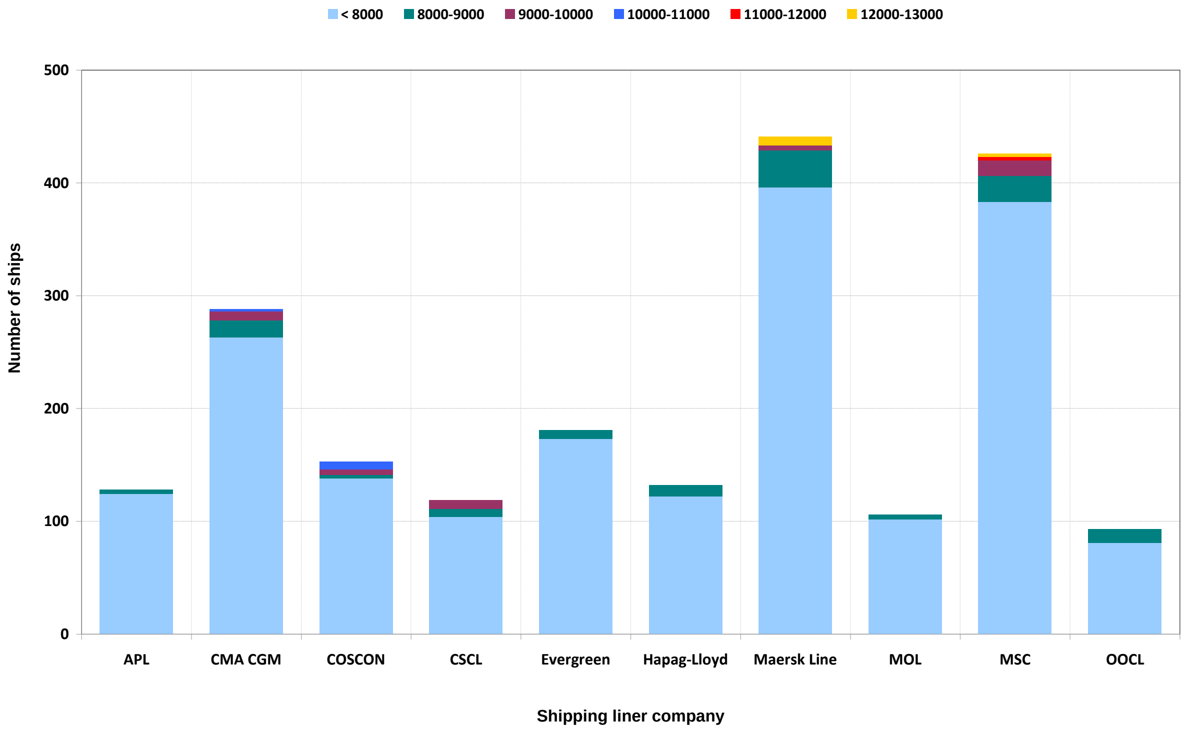

Figure 2.2 *- Actual fleet's composition of top ten liners*

Source: Authors' own elaboration with data of Containerisation (2009)

However, the current order book (Fig. 2.3) reveals that many liners are gradually preparing to the globalised market of mega containerships, by increasing their fleets with new vessels in the 10 000 - 13 000 range. CMA-CGM, COSCON and Zim have ordered the highest number.

This order book shows an unprecedented number of more than 12 000 TEU leading to significant commercial and technical challenges for the shipping industry. A possible scenario has been outlined for the liner market in the near future (Parola and Musso, 2007):

- a few global carriers (both, independent as Maersk, MSC, CMA-CGM, and members of world alliances as APL, COSCON) will deploy vessels in the 8 000-13 000 TEU range adopting hub-and-spoke strategies;
- some operators (such like Hapag-Lloyd, Yang Ming and K-Line) will focus only on some trade routes, using 8 000 - 9 000 containerships but also 4 000 - 6 000 TEUs vessels.

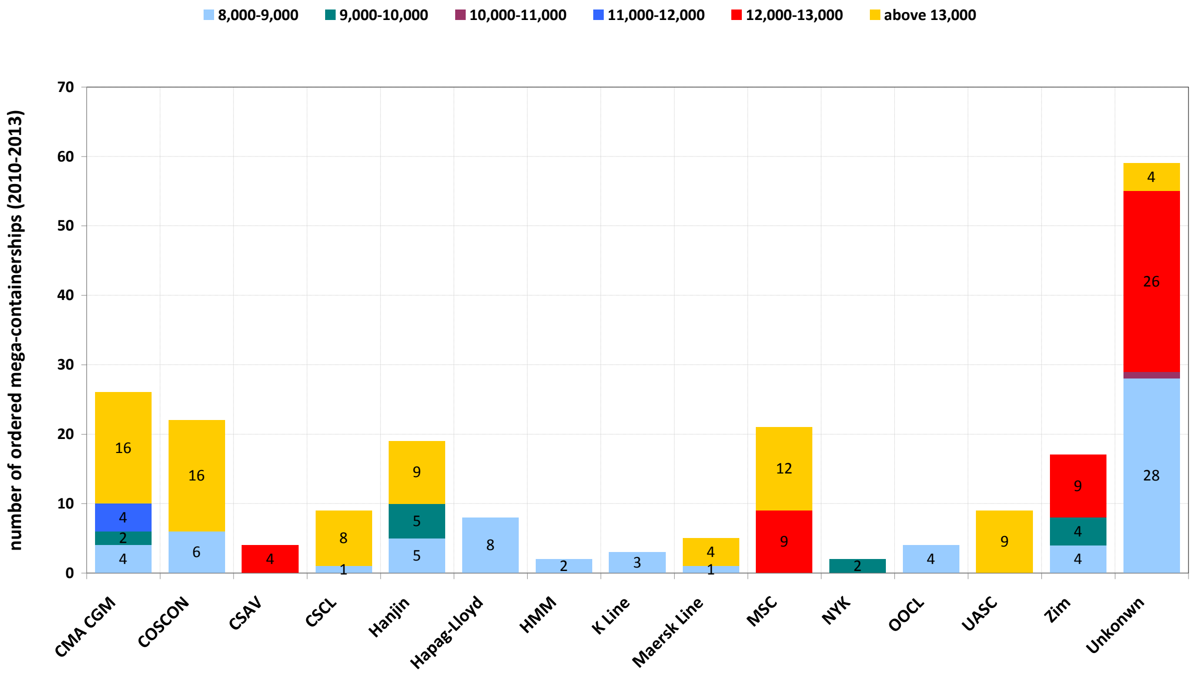

***Figure 2.3** – Liners' vessels orders for the years of delivery 2010-2013*

Source: Authors' own elaboration based on Containerisation (2009)

For our concern, 227 new mega containerships will be delivered between 2010 and 2013. These new buildings will be mostly over 13 000 (34%) ordered by Maersk, MSC, CMA-CGM, COSCON, China Shipping Container Lines (CSCL), Hanjin, United Arab Shipping Company (UASC) and unknown operators, followed by 66 vessels between 8 000 and 9 000 TEU (29%). The "unknown operators" category is the one with the highest rate of ordered mega vessels for the next years; usually it refers to actors which play on the speculation of the market and when a liner requires a container ship of those characteristics for the short- or

mid-term, it is a matter of negotiation with the "unknown operator" due to the 5 year period that a mega vessel needs to be constructed (Theotokas, 2007).
Although many global shipping lines are now looking into the possibility of deploying vessels of more than 10 000 TEU in the next years, as demonstrated by the order book above, the current proportion of mega ships seems still small in relation to the global fleet, as the mega container market is designated for mature markets while the new and the low-growth markets will continue to be served by vessels with low capacity. Indeed, it is expected that this mega vessel size will not become the general rule in the next 10 years (Notteboom and Rodrigue, 2006).

2.3 Risk awareness

Although the number of mega containerships ordered by some shipping lines is progressively rising, it seems quite unrealistic a massive deployment of over 13 000 TEU vessels, such as Suez Max (15 000 TEU) or Malacca-max (18 000 TEU) ships, in the short-medium period. A first limit concerns the fact that mega containerships can be deployed efficiently only on the major trade lanes with appropriate load rates. Even though, many carriers have not been able to meet a continuous dispatch of available slot capacity on their larger vessels (Notteboom, 2004).

A second limit regards technical requirements in naval architecture, since containerships of more than 10 000 TEU capacity represent a technological gap in term of propulsion if the standard commercial speed of 25 or more nautical miles per hour is to be kept (Cariou, 2008). Thus, these mega vessels may require two engines. Twin-propulsion systems are redundant regarding partial loads but have the advantage of being more flexible for all kinds of load, although it will make the new ship significantly more expensive and will require more maintenance effort in operation (Payer, 2002). Moreover, the growth in the number of containers above deck might generate structural pressure on the hull which potentially will cause damages for goods stuffed into containers located on upper levels. For instance, on Emma Maersk, the length of the shaft is 125 m and the height on deck is nine containers which increases the likelihood of damages on the goods.

Another critical issue concerning the capacity of ports to accommodate mega vessels goes in the direction of water depth, equipment and port time which seriously affect these vessels. At present, few ports in Europe are able to offer the proper conditions in terms of infra- and superstructure as well as the inland connections that container in mass require. Consequently, the extensive use of hub and spoke systems for such vessels increases the feeder and transhipment costs for ship-owners (Imai et al., 2006).

In addition, environmental considerations regarding such mega vessels could also represent a limit. For example, a study carried-on by Stapersma and Grimmelius (2003) on the volume of sulphate, nitrate and carbon air emissions generated by containerships, demonstrates that 8 000 TEU vessels might enjoy a clear advantage compared to the 12 000 - 16 000 TEU ones.

Furthermore, many international insurance underwriters have shown concerns over the rising size of containerships pointing out that, in case of a disaster, the total loss of an Emma Maersk-size-like vessel fully loaded with stuffed containers could involve total claims of about US$ 3 billion sufficient to sink the marine insurance market (Sanyal, 2006).

As a consequence of the potential limits above discussed, there is more and more apprehension for the advent of even 18 000 TEU vessels: technically this vessel size is feasible (with the even larger engines already mentioned). Economies of scale are likely to be pushed as far as it is technically and economically feasible (Notteboom and Rodrigue, 2008). The limits to grow will be probably determined by market.

2.4 Strategic routes

In recent years, the largest vessels have been employed only for the major container trade which in the case of Europe involves the voyage to the Far East (Fig. 2.4). Given the volumes of trade, the underlying motivation lies in the optimisation of time and costs at ocean-economies of scale. A ship operator benefits in savings of 4,91 US$ per TEU per day for the time spent at sea by a decision to move from 6,800 to 12,500 TEU vessels (Stenvert and Penfold, 2007).

Interesting features of this trade route relate primarily to its growth represented by the continuously rising Chinese export volumes which contributes also to the considerable east west imbalance ratio. The current state and the projected short- to mid-term market of the mentioned sea-borne route underline a moderate growth linked with the Northern European poles of demand. The maturity of the container trade market and the actual demand saturation largely explain this phenomenon. Although representing just a small share, noticeable growth rates of volumes to Eastern Europe reveal dynamic potentials in the long-term. Furthermore, a secondary axis within the Mediterranean Far-East route, especially running near dense countries like Turkey, might increasingly come to play in the next years (Gardiner et al., 2006).

In the case of European ports the geographical level of investigation reveals that a large number of ports are located along the mega container route (Fig. 2.4). The major pole is the Northern port range followed by the Southern range in Europe. The reason why the latter has been divided into the East- and West-Med, was to illustrate the differences on their vicinity to the major spots of demand. With regards on the Mediterranean market, the natural competitors for the West-Med are the ports in Africa and particularly, the port of Tangier, while ports in the East-Med might compete with the fastest growing ports in Turkey.

A further relevant aspect concerning the mega containerships routes is the different hub-and spoke structure adopted by the two leading operators of the market, Maersk and MSC.

From a conceptual viewpoint, the route operated by Maersk is composed by two intra-continental loops including transhipment hubs (one loop among European ports and the other among Asian ports). In order to connect both loops, a transoceanic transfer or shuttle was chosen (the ocean vessel voyage from hub to hub). An example of this conceptualised route is represented by the case of the largest vessels of Maersk that perform a first loop in Europe, leaving from the port of Zeebrugge towards Rotterdam and Bremerhaven where the mega-vessels stop maximum 2 days in order to collect the flows of containers. Then, the voyage continues to the Algeciras' hub and from there the shuttle navigates until reaching Yantian's hub in Far-East. From this port there is a second loop performed. The Asian loop includes the ports of Shanghai, Ningbo and Hong Kong for the going and return trip.

The route implemented by MSC has a different structure, its mega vessels navigate on a unique-loop-route starting from the West-European port of Valencia and stopping in Gioia Tauro, Piraeus, Salalah, until Singapore. From here the loop continues towards other Far-East hubs, namely, Busan, Qingdao, Shanghai, Ningbo, Xiamen, Hong Kong and Chiwan. Thereon, the ship comes back to Singapore for the reverse route following the same structure.

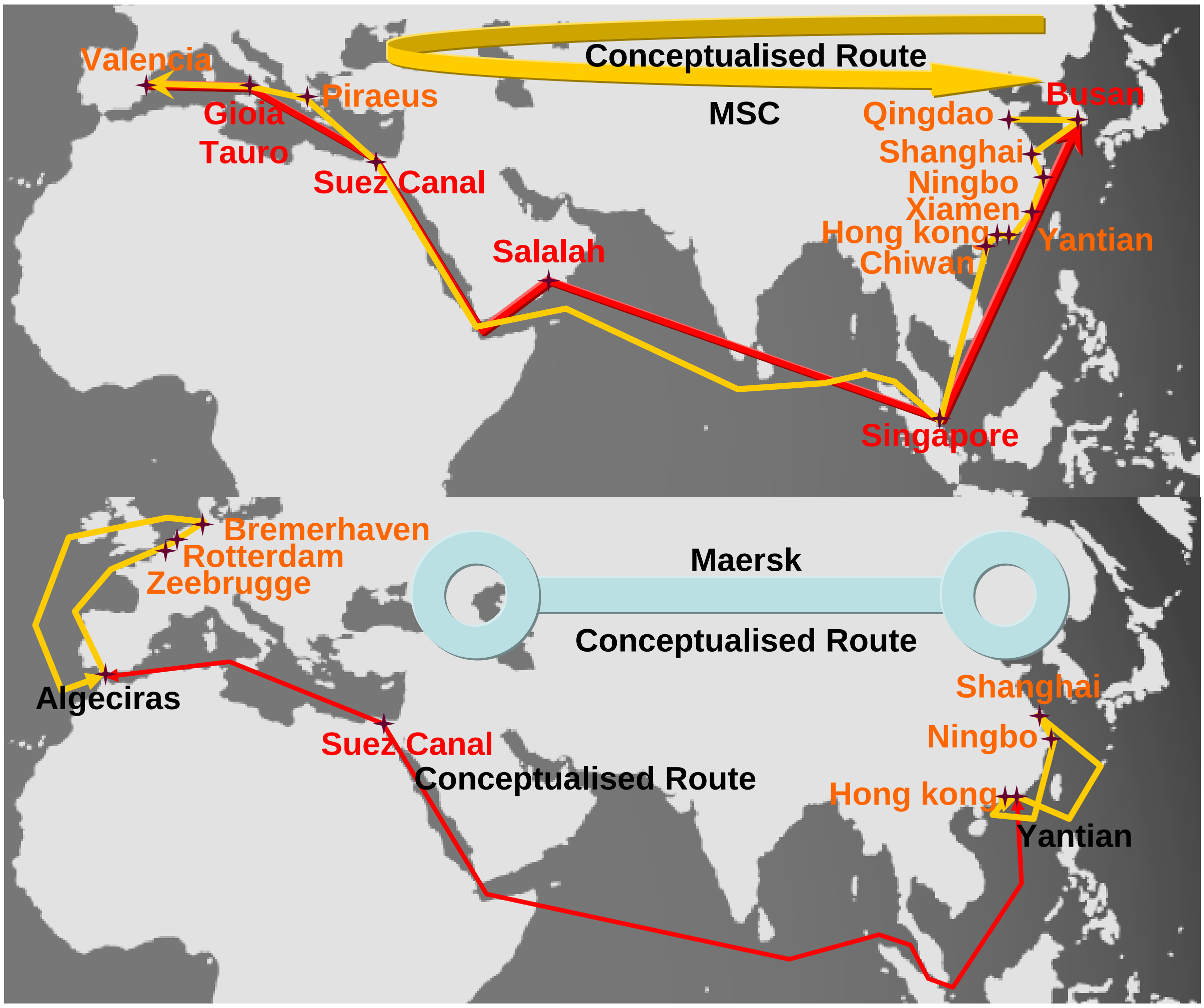

***Figure 2.4** – Strategic mega-container routes*

Source: Authors' own representation

Despite the different structures, the routes developed by Maersk and MSC are based on the hub and spoke concept. The objective behind both structures is to serve all possible hubs with mega-containerships for establishing an economically feasible business strategy. Besides pure transhipment, hubs allow containers' consolidation generating solid flows to be transported by this type of vessels and keeping them constantly on sail.

2.5 Risk sharing

In the 1990s, the progressive concentration in the liner shipping market led to concentration also in the stevedoring market, where terminal operators developed strategies of enlargement of their assets. In fact, a liberalization process in many European ports allowed the concentration of the main stevedores: Hutchinson Port Holdings (HPH) firstly acquired a minority share of Europe Container Terminals (ECT) in Rotterdam and then took over the company. In 2002, Port of Singapore Authority (PSA) took over Hesse Noord Natie, the main stevedoring company in Antwerp. Lastly, in 2005, Dubai Ports (DP) World took over the whole Peninsular & Oriental Steam Navigation Company (P&O) Ports' network in North Europe.

Currently, the main investments, in terms of container port capacity, come from Andreas Peter Møller (APM), HPH, PSA, DP World and China Ocean Shipping Company (Cosco) which constitute the five leading terminal operators with a global presence. In particular, HPH, PSA and DP World can be defined as pure stevedores, whose primary business is port operations, while APM and Cosco are the so-called hybrid terminal operators, whose main activity is container shipping, but where a separate terminal operating division has been established and integrated with their shipping line service network. Furthermore, there are integrated carriers running terminals, such as MSC and Evergreen, which achieve benefits by choosing the best form of co-operation they can obtain. Thus, they are not tied to a specific terminal operator and develop strategic agreements also with local operators (Notteboom, 2007).

What is presently emerging in the container industry is a new reaction of the shipping lines to the process of stevedores' concentration, by adopting various forms of integration along the supply chain to control terminal handling and land operations. Some acquire terminals, others are involved in collaborative ventures with pure stevedores through investing money in terminals (minority shares, joint-venture, majority shares).

The map in Fig. 2.5 shows an overview of the location of the main shipping companies that are currently holding or will hold a share in the main European ports. The mid-shaded logos represent less than 50 percent of the terminal concessions while the cleared logos represent a majority of the terminal concession. Note that strategic points are covered by the major terminal operators in order to control the cargo flows over the European network for increasing the scale of their operations from a local port level to a port network level.

APM results as the first global group operating in European terminals, either with minority or majority shares. Particularly, dedicated terminals operated for Maersk Line are in Algeciras and Rotterdam, while in Bremerhaven there is a 50/50 joint venture Maersk-Eurogate. In South Europe, it has a minority share in Genoa and Gioia Tauro.

The second carrier for presence in Europe is MSC, with four dedicated terminals in Antwerp, Le Havre, Bremerhaven, Valencia, and even a minority share in La Spezia. MSC is generally involved in a joint-venture or in a minority share but does not manage directly the dedicated facility and outsources terminal operations to a local or global stevedoring company. Another liner more and more operative in the European container terminal market is CMA-CGM, with minority shares in the Ports of Le Havre and Antwerp, besides other two dedicated terminals in Le Havre and Marsaxlokk.

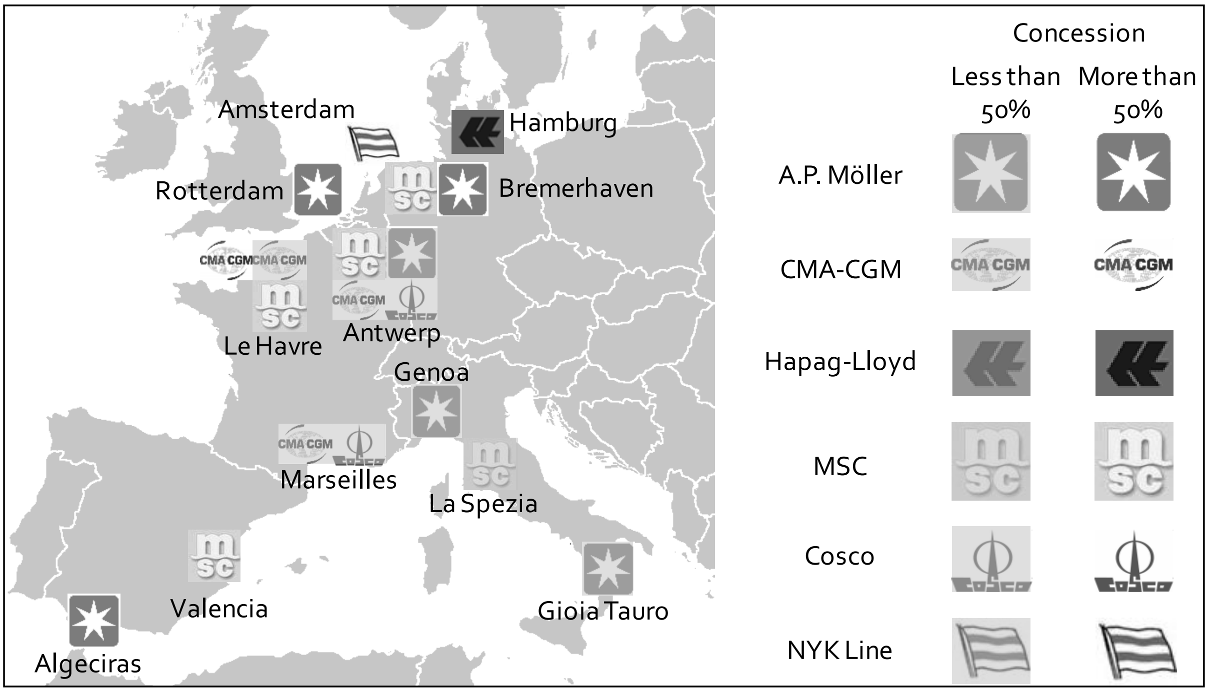

***Figure 2.5** – Position of global shipping lines in Europe*
Source: Authors' own representation

Although some global carriers (i.e. MSC, CMA-CGM, Hapag-Lloyd, etc.) are being increasingly active in this market, the power of pure stevedores remains strong, especially in the Northern range. As a consequence, some liners are increasing their presence in the Mediterranean and in the Black Sea by investing in ports such as Genoa, Valencia, Marsaxlokk, to provide direct call services from Asia to the Mediterranean.

The competition not only involves the most important actors in the shipping industry but it influences the ports themselves. With the development of the maritime network the enforcement for efficient infrastructure is induced too. Ports can not neglect this phenomenon and must react to the needs of the maritime demand and this is actually happening at Asian, European and American ports. The problematic again is the diffusion of the container to the demand points which will be the future bottleneck of transportation.

2.6 Ports' technical requirements

The latest generations of containerships have led terminal operators and ports to invest in additional infrastructure, cranes, channel depth, productivity, etc. The inability to handle cargo at the required place in intermediate hubs and their hinterlands eliminates the benefits offered by consolidation of containers through mega vessels.
Currently, there are two designs for mega vessels under development (Stenvert and Penfold, 2007):

- The 12 500 TEU design, which maximizes employment of a single engine, with fully laden draught until 14.5-15 meters. This allows the vessel to call at major deep-sea ports, even imposing a slower speed of around 24 knots.

- The 14 500 TEU design is suitable for operators having their own dedicated terminals and still employs a single engine, but uses a deeper maximum draught to achieve a very high loading. By using a finer hull form (with beam limited to 58 m - i.e. 21 containers), the speed is not limited, but the maximum draught reduces the range of port calls where the vessel can call fully loaded. Access channel clearance should be at least 10 per cent at most ports and as much as 15 per cent at some.

As a consequence of these two designs, port demand will be focused on terminals with a berth depth between 15.3 and 16.3 m for accommodating mega vessels drawing 14.5-15.0 m. The terminals will also require gradually longer berths, superior to 400 m which is the current standard at major deep-sea terminals. The general development of containerships' specifications since the early 1980s is indicated in table 2.1; besides, it provides an indication of berth and depth requirements for port infrastructure.

Generation	Type	Capacity (TEU)	Length (m.)	Beam (m.)	Max. Draft (m.)	Depth (m.)
First generation (1956-1970)	Adapted vessels	1100 - 2000	200	24,0	9,0	9,5
Second generation (1970-1980)	Cellular structure	2000 - 3000	213	27,4	10,8	12,0
Third generation (1980-1990)	Panamax	3000 - 4500	281	32,0	12,7 - 13,5	13,1 - 14,0
Fourth generation (1988-1995)	Post-panamax	4500 - 5000	280-305	41,1	13,5 - 14,1	14,0 - 14,5
Fifth generation (1996-2005)	Super post-panamax	5000 - 9200	300-367	45,6	14,0 - 15,0	14,5 - 15,5
Mega containerships (from 2006)	Mega post-panamax	> 9200	370-400	45,0 - 56,4	15,0 - 15,3	15,5 - 16,3

Table 2.1 *– Infrastructure requirements of the largest containerships*
Source: Adapted from Stenvert and Penfold (2007)

In Europe only few ports, today, can satisfy these depth requirements. In particular, according to a classification made by Davidson in 2004, the ports with the maximum depth in the Northern range are Hamburg (16,7 m.), Rotterdam (16,6 m.) and Antwerp (15,5 m.). The deepest ports in the Southern range are Piraeus (16,5 m.), Algeciras (16 m.), Valencia (16 m.) Barcelona (16 m.) and Malta (15,5 m.).

The increase in ship size implies also evolutions in cargo-handling technology. Quayside cranes need to become larger, and their outreach greater. Even yard systems have evolved in order to keep up the flow between quay and yard by introducing higher-stacking yard cranes (typically rubber-tyred gantries or straddle carriers) and by computerizing solutions to rationalize movements of equipment within a yard.

With a length of 400 m., a beam of 60 m., and a draft of more than 15 m., mega vessels impose depth requirements also on access channels. This implies onerous dredging investments - especially for maintenance - for ports not located near deep water, especially at riverine locations. Antwerp is a typical example of port subject to lock operations and with a tidal access channel of 80 km. Channel depth and tidal windows are critical in Hamburg and Bremerhaven too. On the Europe-East Asia trade, draft limitations and tidal windows are becoming relevant variables, as many Chinese ports and some load centres in the Le Havre-Hamburg range are increasingly facing difficulties in accommodating the latest generations of container vessels at all times (Notteboom, 2006).

3 PORTS' INCENTIVES TO RECEIVE MEGA CONTAINERSHIPS

The present section aims to reveal the financial drivers that move ports to invest in the current mega container vessels' market. Two particular cases were developed. The first refers to the revenues that a mega containership is actually paying to the port of Rotterdam. The second case is based on the hypothesis that the port of Antwerp could receive this type of vessels. Both results show that this niche market importantly contributes to the overall revenues of both ports.

3.1 Real revenues for the Port of Rotterdam

Mega-container vessels are linked with economies of scale for the owner (e.g. Maersk Line, Mediterranean Shipping Company, Compagnie Maritime d'Affrètement - Compagnie Générale Maritime, etc.), for the terminal operator (e.g. Hutchison Port Holdings, Andreas Peter Möller, Port of Singapore Authority, etc.) and less as it is thought for the Port Authority. In order to illustrate the port interest in receiving the largest vessels we aim to quantify the benefits for two Port Authorities to participate in this market segment: Rotterdam and Antwerp.

According to the fleet analysis (section 2.2) since the year 2006 only the liner shipping company Maersk owns mega container vessels of more than 11 000 TEU. Indeed the PS series of Maersk officially operate eight vessels with an official capacity of 11 000 TEU (Maerskline, 2008). Often, the first of this type of vessels, the Emma Maersk has been mentioned in literature as the biggest mega containership and its capacity has been linked from 13 500 to 15 000. According to Maersk, this capacity is reduced since calculations over its capacity are based on the maximum capacity of storage and considering a load factor of 65 percent per container (14 ton), however the load factor used by Maersk itself is 80%

reducing the 13 750 capacity to 11 000. The same calculation holds for the Ebba, Edith, Eleonora, Elly, Estelle, Eugen and Evelyn Maersk vessels. In total all of them have an official capacity of 88 000 TEU.

Based on a real case, data was obtained of four of the biggest vessels types of Maersk and a correlation was found on the route that these vessels follow. This route is shown in Fig. 2.4. From the route only 3 ports are called by this kind of vessels, namely, Algeciras, Rotterdam and Bremerhaven. With regards on the specification of the vessels data was obtained from different sources (follow references by name of vessel).

From the part of the Port Authority, tariffs were available (Rotterdam, 2008) for calculating the income based on gross tonnage, capacity of main engine (Kw) and length overall (LOA). It is important to underline the composition of the port's income for a better understanding of Fig. 3.1. Harbour dues refer to a total amount paid for a scheduled vessel arriving to the Port and unloading and/or loading 51,6 percent or more of its total capacity. Otherwise, harbour dues are spread in two components: fix harbour dues and tonnage of unloaded and/or loaded dues. Fix harbour dues are calculated on the vessel's gross tonnage, while the tonnage dues are calculated on the basis of metric tonnes of loaded and/or unloaded cargo instead of number of containers. This is the reason why the composed structure of income (right) is higher than the first (left) in Fig. 3.1. Fuel residue/sludge, used motor oil and bilge water are taxed (fuel rate) by the local authority and this rate is based on the main engine of the vessel. For all vessels of more than 8 000 TEU capacity the main engine works on more than 30 000 Kw equal to the highest rate. Plastic waste is also taxed with the same procedure. The port call is taxed on a 24 hours flat rate basis according to the LOA, the larger the vessel the higher the rate. The same procedure is applied to buoy and dolphin rate at different amounts. Note that dolphin rates refer to the usage of structures for mooring a vessel.

The results of the compared vessels are shown in Fig. 3.1. The highest income for the port is obviously paid by the mega container vessel rising up to approximately 87 750 Euros (in 2008) per port call. Each vessel shows two income structures. The first (at left) refers to the amount paid by the vessel to the harbour according to the case of unloading and/or loading 51,6 percent or more, while the second shows the calculation based on a vessel unloading and/or loading the maximum amount for a composed income structure (51,5 percent). Notice the capacity of each vessel is noted over the income structures.

It is important to underline the difference in income for the Rotterdam Port Authority between a port call of the PS series and the next lower one in capacity: Maersk Altair. This difference rises up to 26 percent equivalent to almost 23 000 Euros in 2008. From the Maersk Altair to the Arnold Maersk the difference is equivalent to 9,5 percent and from the Arnold to the Maersk Taikung is equal to 1,4 percent. From these observations the amount seems huge, but that is when the economies of scale play an important role since small increases are added per container. For the Emma Maersk the cost per container for the Port is equal to almost 7,92 Euros while the Altair amounts almost 6,23 Euros and the Arnold and Taikung vessels costs are 5,66 and 5,80 Euros. Note that the cost of the port call per container are higher for a vessel of 8 112 than for the 8 292 TEU capacity. This phenomenon is a consequence of the increased gross tonnage of the Taikung vessel on which the harbour dues are based. The major difference in rates for both, Altair and Emma, is due to the average stay of 2 days for loading and/or unloading containers for the Emma Maersk according to the real stay of this vessel (Maerskline, 2008).

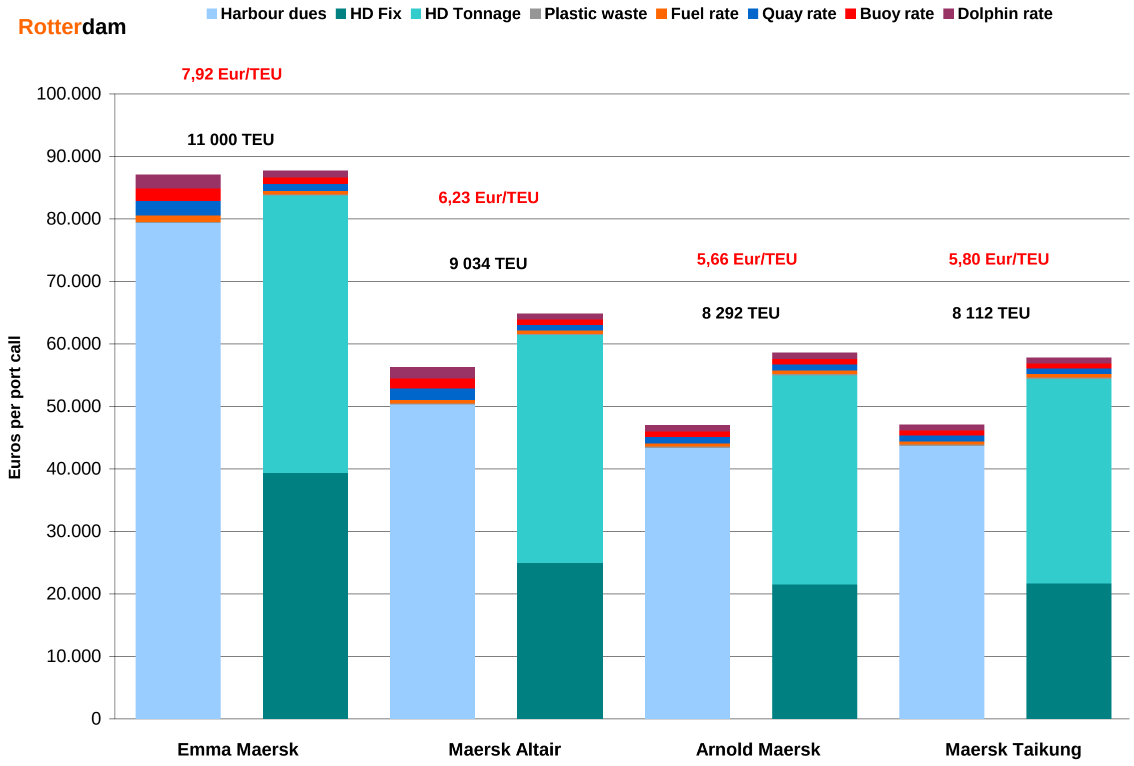

Figure 3.1 *Total dues and rates of container vessels calling at Rotterdam*

Source: Authors' own representation

From the numerical example above, one can underline that every PS series vessel arrives at the port of Rotterdam with a medium frequency of one vessel per week based on the Maersk schedules for the period available launching from March to September 2008. Discounts are not possible since the rotation for every vessel equals to eight weeks. However, the voyage from an Asian to a European port is 13 days. Assuming a frequency of 13 days for the year 2008, the income form mega vessels for the Port of Rotterdam contributes to 4 percent of the total port's income in 2007. At the same time, this contribution is comparable to 0,2 percent of the port's total capital invested in 2007. If we consider the lack of port calls of mega container vessels, the amount of income for the port covering the same quantity of containers with normal container vessels falls to 0,6 percent of the net income in 2007 and 0,03 percent of the capital invested for the same year. The total of loss would be equivalent to 672 000 Euros in 2008.

3.2 Hypothetical revenues at the Port of Antwerp

Let Antwerp receives the same type of mega container vessels with the same characteristics as in Rotterdam. In the case this kind of ships would be able to turn at the inner-access channel and the Schelde terminals could receive them, a question raises on how much would be the benefit for the port of Antwerp.

For benchmarking both ports, the tariff calculation should be explained for the second port. In Antwerp, as opposed to Rotterdam, there is only the composed harbour dues structure. There, a part is fixed according to the gross tonnage and the second element is calculated on the basis of the loaded and/or unloaded metric tonnes (Tariefverordening, 2008). However, the port dues and rates are significantly lower than in Rotterdam. In Fig. 3.2 the income for the port of Antwerp per port call of the same vessels as for the Rotterdam case is shown.

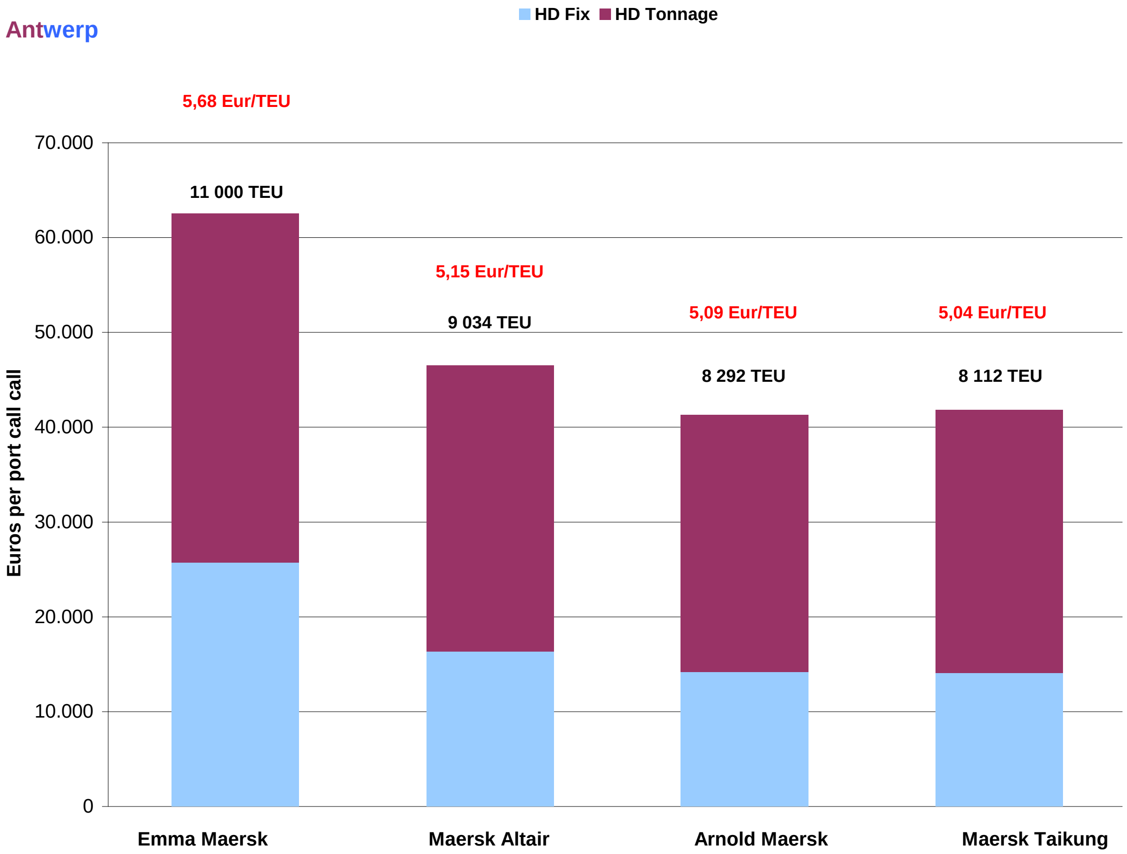

Figure 3.2 *Generated container vessels' dues calling at Antwerp*

Source: Authors' own representation

Note that the difference of receiving the Emma to the Altair is stable, 26 percent remains the same difference for both ports. However, the total revenues in between Rotterdam to Antwerp drop to 29 percent for the Belgian port. This phenomenon is present according to the lack of receiving this type of ships. An important issue for the port of Antwerp is the opportunity revenues that could receive in case of participating in the mass container market.

The percentage difference from receiving the Altair to the Arnold is equal to 11 points, while -1 percent is the difference from the Arnold to the Taikung.

An important issue to underline is the port dues and rates per container. Rotterdam port is more expensive for 2,24 Euros concerning the Emma Maersk, while the Taikung is only 1,08 Euros more expensive in Rotterdam. Therefore, the Port Authorities have a high incentive to entry in the new market of containers in mass, according to what they receive per container, since the total amount for the Emma case records 62 500 Euros (2008) per port call in Antwerp for instances. Considering one vessel is arriving in Antwerp per week (PS series frequency in Europe), the expected revenue (2008) would be 4,53 Mio Euros for the Port Authority of Rotterdam, while 3,25 Mio would be the amount per annum for Antwerp receiving the same quantity of vessels. This activity segment corresponds to 5,3 percent and 7 percent of the total container throughput for Rotterdam and Antwerp respectively.

4 CONCLUSIONS

The performance and developments of the maritime sector have fostered the best growth on movement of goods during the last years. The source of this eminent development is the invention of the container and the ever increasing use of the box (containerisation). Indeed, products that are thought to be transported by raw modes of transport are today shipped in containers. Furthermore, the containerisation effect has boosted the maritime actors to constantly develop their strategies for shipping goods to the ports.

The maritime sector has no failed on providing services that are required for the global economy. First, the profits on the maritime network connections have been already attained even though this is a branch that will always be in constant development. Second, the risk that shipping liners run by owning and commanding mega vessels has ended up to the spread of these risks by means of alliances with the terminal operators. This issue have positioned shipping liners at a level where they can even perform hinterland services. Third, the trend of ever increasing the size of the vessels has led to the strategies of the maritime actors to be well positioned for the future hub and spoke market that has already started but only for two major shipping liners and one maritime route. More contributions to this market are expected to come during the next years according to the analysis of the global carriers' fleets and their order book.

The actual routes established by the two “mega”-liners show a strong link between consolidation and the hub & spoke concept. The main issue is to catch-up the most solid flows and to keep the vessels' sailing. Two main hub & spoke structures are the core of both maritime companies' routes: the European and the Asian zones. However, only the Far East-Europe route is still being used for the exploitation of mega-containerships. The next step will be to follow how the other companies will tackle the financing problems on the new mega-vessels and how they will keep these vessels sailing.

The port system has shown an evolution to a point that maritime pressure and competition itself positioned ports to the hard question of deciding whether participating on the future market of container in mass or just contributing to the spill-over effects that this market will generate. The problem here is whether the port can create the conditions to be considered as a strategic port and this issue is linked with costs, business strategies, geographical position, infrastructure requirements and hinterland connections. However, no matter which decision each port will take, the interest of serving this market is an economic incentive itself which ports can not easily deny.

REFERENCES

Altair and Taikung, (2008) Specifications of the Maersk vessels, Consulted in April 2008, <http://www.apmsingapore.com.sg>

Antwerp, (2006) Annual Report, Ernst & Young accountants, Antwerp Port Authority, Antwerp, Belgium.

Cariou, P. (2008) Liner shipping strategies: an overview, International Journal of Ocean Systems Management, Vol. 1, No, 1, 2008, 1-13.

Containerisation (2009) Database of new builds and ship fleet, Containerisation International, consulted in February 2009, <www.ci-online.co.uk>

Davidson, N. (2004) Mega containerships: How big is too big?, Drewry Shipping Consultants Ltd., Presented at TOC Europe, Barcelona, Spain.

Emma Maersk, (2008) Emma Maersk / Container vessel specifications, A.P. Møller-Maersk Group, <www.emma-maersk.com/specification/>

Gardiner, P., Williamson, G. and Garg, S. (2005) The Drewry Annual Container Market Review and Forecast 2005/2006, Drewry Shipping Consultants Ltd., London, U.K.

Imai, A., Nishimura, E., Papadimitriou, S. and Liu, M. (2006) The economic viability of container mega-ships, Transportation Research E: Logistics and Transportation Review, Vol. 42, pp. 21–41, ISSN: 1366-5545.

Maerskline (2008) Schedules of Maersk vessels, Consulted in April 2008 in: <www.maerskline.com>

Notteboom, T. (2004) Container shipping and ports: an overview, Review of Network Economics, Vol, 3, No, 2, June, pp. 86–106.

Notteboom, T. (2006) The time factor in liner shipping services, Journal of Maritime Economics & Logistics, 2006, 8, 19–39, Rotterdam, The Netherlands.

Notteboom, T. (2007) The changing face of the terminal operator business: lesson for the regulator, ACCC Regulatory Conference, Gold Coast, Australia.

Notteboom, T. and Rodrigue, J.P. (2006) Challenges in the Maritime-Land Interface: Maritime Freight and Logistics, Report prepared for the Korean Government, Ministry of Maritime Affairs & Fisheries, The Master Development Plan for Port Logistics Parks in Korea.

Notteboom, T. and Rodrigue, J.P. (2008) Containerisation, Box logistics and Global Supply Chains: The integration of Ports and Liner Shipping Networks, Journal of Maritime Economics and Logistics, Vol. 10, No. 1-2, 152-174, Rotterdam, The Netherlands.

Parola, F. and Musso, E. (2007) Market structure and competitive strategies: the carrier-stevedores arm wrestling in North European ports, Maritime Policy and Management, Vol. 34, No. 3, 259-278, London, U.K.

Payer, H. (2002) Economic and Technical Aspects of Mega-Container Carriers, Proceedings of IAME Annual Conference and General Meeting, Panama City, Panama.

Rotterdam (2007) Annual Report, Ernst & Young accountants, Havenbedrijf Rotterdam N,V, December 2007, Antwerp, Belgium.

Sanyal, S. (2006) Mega container ships come with jumbo problems. Business Line, Ninestars Information Technologies Ltd. Published by Kastury & Sons Ltd., Chennai, India.

Stapersma, D. and Grimmelius, H.T. (2003) Trends in Propulsion and Operation of Container Ships, pp.31–41, The Royal Institution of Naval Architects, London, U.K.

Stenvert, R. and Penfold, A. (2007) Container Port strategy, Emerging issues, Ocean Shipping Consultants Ltd., Chertsey, England.

Tangier (2008) Maersk Tangier port to handle 1 mln TEU this year, Reuteurs, April, 2008, <www.reuters.com>

Tariefverordening (2008) Tariefverordening op de zeeschepen, Port of Antwerp, December 2007, Antwerp, Belgium.

Tariffs (2008) Port Tariffs, Havenbedrijf Rotterdam N,V, Consulted in April 2008, <www.portofrotterdam.com>

Theotokas, I. (2007) Strategies of actors: New organizational patterns in the shipping industry, Lecture of the Maritime transport sector, 1st TransportNet stream course on Transport Markets and Businesses, Department of Shipping, Trade and Transport, University of the Aegean, Chios, Greece.

Woodbridge, C., Choudhary, M. and Sharma, K. (2008) The Annual Review of Global Container Terminal Operators, Drewry Shipping Consultants Ltd., London, U.K.