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CONTAINER SHIPPING FROM EAST ASIA TO EUROPEAN MEGAPORT

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The purpose of this thesis was to examine in detail the process and structure of container shipping from the point of their transportation by ocean on the liner route between Europe and East Asia.

By reason of my research's specificity, I was not able to use any case company in the thesis. Therefore, I independently attempted to select the most appropriate subjects for the study. I collected the different existing information from open sources as the theoretical framework and analysed all for applying as a basic research method.

The primary issue of the thesis is the containerization including its forming segments and a role in the maritime industry. There are also considered the types of vessels that carry container cargo by ocean. Nevertheless, the main focus of the thesis is container terminals at the ports in East Asia. Additionally, a benchmark for this examination has been chosen the Port of Rotterdam which has taken a position of the most successful sample in the port industry.

In general, the results of my thesis may be assisted for students who want to improve knowledge in containerized shipping industry and could be applied for the future research devoted this field of the study.

CONTENTS

1 INTRODUCTION

The importance of maritime shipping in world economy development has been defined by researchers and economists as the key element of international trade on a global basis. During the previous 25 years, globalization has resulted not only in changes of international logistics service and trade markets but also in technological development of transport sector and port industry. As a phenomenon, globalization has widened of “cross-border networks and flows” and led many countries to liberalize trade aiming to the access to lower costs, technology and finally higher productivity.(Branch 2009, 79; Tangredi 2002, 4).

Undoubtedly, these changes in particular would not have occurred without the evolution of the maritime transport. Starting mainly after 1950s, technical improvements and modernization of seaborne fleet, including bulk carriers, super-tankers, vehicle carriers and, of course, container ships, have allowed to integrate national economies of countries separated by oceans into the global trade. (Stopford 2009, 35-41).

Furthermore, containerisation system as an important element of not only international maritime transportation, but also of entire world trade has affected the port industry and the organisation of manufacturing particularly in East Asia. Thereby, due to unceasing globalization resulted in the expansion of word economy over the last two decades, this fastest growing region including China, South Korea, Malaysia, Hong Kong, Indonesia become “new sources of supply for department stores in Europe”, and United States as well. All these economics, environmental and social factors influenced maritime industry occupied a central position in Asian domain and led to significant modifications in the technological infrastructure of terminals as well as to crucial changes in the operating performance of ports. (Branch 2007, 359-360; Chew, Lee & Tang, 2011, 4).

1.1 Background of thesis

In this regard, the research aims to provide a comprehensive study of container shipping industry with practical explanation of how this system works within the entire maritime transport network. It requires examination of geographical framework within which maritime trade operates including such options as locations of the largest container ports in Europe and East Asia.

In particular, the study contains a description of containerization segments, a summary of its advantages and disadvantages, and standard types of container in use. In research is drawn attention to cargo types and vessels that are carrying containers with concise categorization of merchant ships. The more detailed investigation of this work focuses on the analyses of the major container ports of East Asia covering their administration and container-handling operations.

In the thesis is included the statistical data fromthe report by United Nations Conference of Trade and Development (UNCTAD) published in 2015.

1.2 Research problems and questions

The principal questions that are answered in the research are the followings:

- what is the current position of the container shipping markets in the international seaborne trade by examining EU and East Asian regions.

- what types of container are used, and what features of containerization should be noted;

- how does the shipping industry transport containerized cargo today, and what division of vessels provide this service;

- what is the role of ports in the global transport system, and how do they operate with container handling focusing on the three largest container ports in East Asia: Shanghai, Singapore and Busan;

1.3 Research methodology

As a methodology for collecting the core data was chosen a theoretical analysis mainly based on open resources and literature reviews. Generated theoretical material was organized in the research into sections by topic from the general to the primary subject.

Additionally, it was explored the secondary data namely existing statistical information published by the competent organizations which was analyzed in term of its applicability. The research was based on a deductive approach linked to the theory-testing and quantitative analysis of datasets.

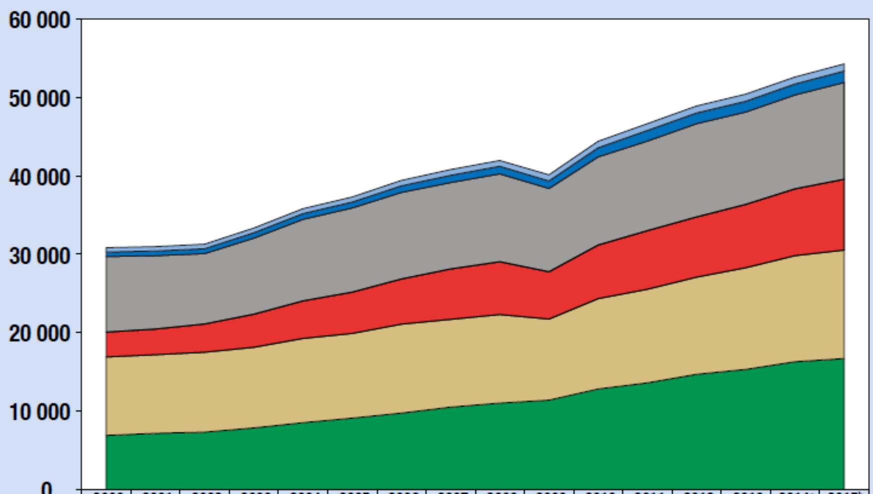
The result of my research was performed as guidance for multifarious audience who intend to understand of important elements of the global container shipping within close interaction between international trades, logistics service, the types of vessels, and operations of the largest container ports situated in the region of East Asia.

1.4 Boundaries of the project

In the thesis will be not handled such issues as technical descriptions of vessels, optimization of waiting time, storage and warehousing management, costs' structure and concepts, evaluation of risks, and problems of pollution.

2 THE WORLD MARITIME TRADE

In our modern era, maritime trade industry has become ‘the backbone’ of world trade and globalization fulfilling a critical economic function. Between 2000 and 2014, the demand for shipping services and tonnage has raised from 30,823 billion to 52,572 billion ton-miles, by almost 40%, as it was reported in the Review of Maritime Transport by UNCTAD shown in Figure 1. The ton-mile unit is applied for statistical measurement of freight transportation capacity over time. Thus the analysis of represented diagram reveals that the most dynamic sector of global seaborne trade is recognized containerised cargo shipping. While dry and liquid bulk commodities are remaining the weighty groups of cargo trade, ton-miles generated by containerized trade have increased by almost 63% over than 15 years. Indubitably, this dynamic growth is worth paying attention for a detailed examination. (Review of Maritime Transport 2015, 14-15).



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014[a]	2015[b]
Chemicals	552	562	593	606	625	651	689	724	736	765	824	864	889	908	899	912
Gas	576	591	611	662	719	736	833	913	956	958	1 147	1 344	1 346	1 347	1 382	1 444
Oil	9 631	9 352	8 971	9 698	10 393	10 729	11 036	11 011	11 200	10 621	11 237	11 417	11 890	11 779	11 969	12 339
Container	3 170	3 271	3 601	4 216	4 785	5 269	5 757	6 422	6 734	6 030	6 833	7 469	7 673	8 076	8 514	9 024
Other (minor bulks & other)	9 998	10 023	10 167	10 275	10 729	10 782	11 330	11 186	11 272	10 325	11 504	11 927	12 375	12 952	13 514	13 833
Five main dry bulks	6 896	7 158	7 331	7 852	8 527	9 107	9 745	10 503	11 028	11 400	12 824	13 596	14 691	15 312	16 294	16 685

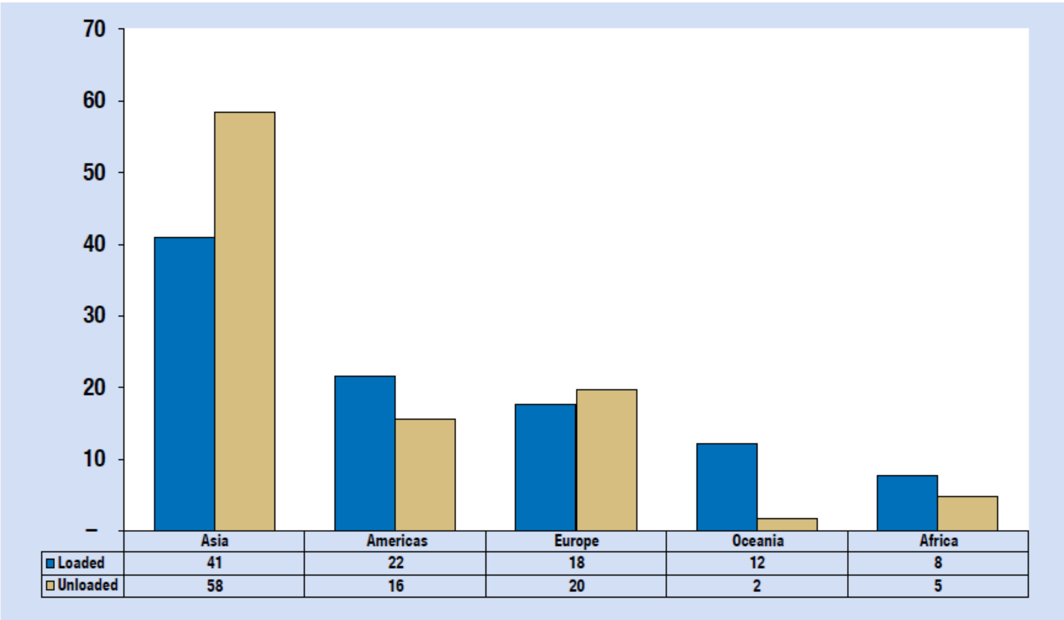
Source: UNCTAD secretariat, based on data from Clarksons Research (2015b).
[a] Estimated
[b] Forecast

Figure 1.World seaborne trade in cargo ton–miles by cargo type, 2000–2015 (billions of ton–miles). (Review of Maritime Transport 2015, 15).

2.1 The maritime trading geographical framework

In recent times, the three economic regions where maritime industry prevails mainly are North America, Europe, and Asia which has become the leader in import and export in 2014, as it is shown in Figure 2. This illustration gives visual demonstration of main trade routes connected by the Panama and Suez canals passing the North Atlantic, the Pacific and the Indian Ocean. Black lines in the Map 1 (Appendix 1) mark the major shipping routes between these regions which are performed by containerships and other specialized vessels passing through the Suez Canal. (Stopford 2009, 384).

As this research is organized around the two sectors of word seaborne trade, the EU "which is still just the largest maritime trading area, but with a mature economy and relatively sluggish trade growth" and Asia "which has become the powerhouse of growth in the twenty-first century", the further review will focus more detail on major container ports in these trading areas. (Stopford 2009, 384).



Sources: UNCTAD secretariat, based on data supplied by reporting countries and as published on the relevant government and port industry websites, and by specialist sources. Estimated figures are based on preliminary data or on the last year for which data were available.

Figure 2. Maritime trade by region, 2014 (in word tonnage). (Review of Maritime Transport 2015, 13).

2.1.1 European Shipping Areas and Ports

With population of 508.2 million on 1 January 2015 and a GDP of 13.9 trillion € produced by 2014, Europe’s seaborne trade plays a leading role in the world shipping industry in spite of the fact that reserves of the major raw materials are now depleted and expensive to produce by local industries. Surrounded with water on all sides except the border with Russia in the east, Europe is considered as a very effective trading area with maritime transport playing a major part in its economy. Geographically, “Europe’s west coast faces the Atlantic Ocean, with the Baltic Sea to the north, the Mediterranean Sea to the south and the Black Sea to the east” (Map 1, Appendix 1). (Stopford 2009, 365-366).

Although the total tonnage of goods handled in Europe’s largest ports have increased slightly in 2013 in comparison with previous year, the north-west coast remained one of the intensive shipping areas in the world. In the second quarter of 2015, Europe's top three ports - Rotterdam, Antwerpen and Hamburg - have handled at most 947 million tonnes of the gross weight of goods (Figure 3, Appendix 2). The Dutch port of Rotterdam alone accounted for more than 9% of the total tonnage handled in 2013. With close to 11 million TEUs, Rotterdam stays a principal route in terms of volume of containers moving to Europe. Hamburg consolidated its position as the second largest container port in Europe by handling more than 9 million TEUs, while nearby Antwerpen with more than 8 million TEUs in 2013 (Table 1, Appendix 3). (Website of European statistics: Statistics Explained 2016).

2.1.2 Asian Shipping Areas and Ports

The Asia-Pacific region, “stretching from Japan in the north down to Indonesia in the south and to India and Pakistan in the west”, economically are grouped with four groups. (Stopford 2009, 373-74).

The first group is Japan and South Korea. These ‘mature industrial economies’ support “a major concentration of maritime activity, including two-thirds of the world’s shipbuilding capacity". The second group includes the third market in the world – China – that has a long coastline from Dalian to Shenzen. Third, Singapore, Thailand, Cambodia, and Vietnam are bounded by the Indian Ocean. Finally, on the southern side of the China Sea are located the most populated island countries - Malaysia, Indonesia, and the Philippines. In 2014, Asian countries together loaded 3,826.8 million tons of cargo and unloaded 4,897.2 million tons in 2014. (Stopford 2009, 373-74; Review of Maritime Transport 2015, 8-9).

China

With a population of 1.4 billion and GDP of $10.3 trillion gained in 2015, China continues to be "a global powerhouse" still having "an enormous local and international influence". Among of more than 40 ports in the country, the biggest of them are Dalian, Tianjin, Shenzhen and Shanghai. Shanghai located at the mouth of the Yangtze River has a position the world's busiest container port handling35 million TEU in 2014 (Table 2). Situated in the south of the Pearl River Delta, Shenzhen Port is followed Hong Kong and had 24.0 million TEU of the container throughput in 2014". (Stopford 2009, 376; Branch 2009, 130; Website of Countrymeters 2016; Website of Trading Economics 2016).

The other major container ports in China are Guangzhou and Qindao both handling with 16.6 million TEU in 2014 (Table 2). Port Dalian being a natural harbour is now a major center for oil and chemical production as well as Tianjin is chiefly regarded as a major iron ore port in the region. (Stopford 2009, 376; Review of Maritime Transport 2015, 69).

Southern and eastern Asia

The domain of Southern and eastern Asia is described as "the best suited to seaborne trade", the coast-line of which "stretches through 18 countries mainly strung out along the bottom of the Asian continent". The development waterway networks provide easy access to inland areas reducing investment in transport infrastructure. (Stopford 2009, 377)

In 2014, Singapore, located at the southern tip of the Malaysian Peninsula, and Hong Kong, situated off southern China, took places of the two largest container ports in world, lifted 33,9 million and 22.2 million TEUs, respectively (Table 2). (Stopford 2009, 377; Review of Maritime Transport 2015, 69).

South Korea situated at the North-East of the trading area has 10 million hectares of the land area. In 2014, the country achieved GDP of $1,410 billion that is closely to the rate of Japanese growth in 2010. Pusan, the principal ports of South Korea, situated on the south-east corner of the Korean Peninsula, was handling 18.6 million TEU in 2014 (Table 2). (Stopford 2009, 377; Review of Maritime Transport 2015, 69).

Table 2. Top-20 world's largest container ports, 2012-2014 (TEUs and percentage of change). (Review of Maritime Transport 2015, 15)

Port Name	2012	2013	2014	Percentage change 2013–2012	Percentage change 2014–2013
Shanghai	32 529 000	36 617 000	35 290 000	12.57	-3.62
Singapore	31 649 400	32 600 000	33 869 000	3.00	3.89
Shenzhen	22 940 130	23 279 000	24 040 000	1.48	3.27
Hong Kong	23 117 000	22 352 000	22 200 000	-3.31	-0.68
Ningbo	15 670 000	17 351 000	19 450 000	10.73	12.10
Busan	17 046 177	17 686 000	18 678 000	3.75	5.61
Guangzhou	14 743 600	15 309 000	16 610 000	3.83	8.50
Qingdao	14 503 000	15 520 000	16 580 000	7.01	6.83
Dubai	13 270 000	13 641 000	15 200 000	2.80	11.43
Tianjin	12 300 000	13 000 000	14 060 000	5.69	8.15
Rotterdam	11 865 916	11 621 000	12 298 000	-2.06	5.83
Port Klang	10 001 495	10 350 000	10 946 000	3.48	5.76
Kaohsiung	9 781 221	9 938 000	10 593 000	1.60	6.59
Dalian	8 064 000	10 015 000	10 130 000	24.19	1.15
Hamburg	8 863 896	9 258 000	9 729 000	4.45	5.09
Antwerp	8 635 169	8 578 000	8 978 000	-0.66	4.66
Xiamen	7 201 700	8 008 000	8 572 000	11.20	7.04
Tanjung Pelepas	7 700 000	7 628 000	8 500 000	-0.94	11.43
Los Angeles	8 077 714	7 869 000	8 340 000	-2.58	5.99
Jakarta	6 100 000	6 171 000	6 053 000	1.16	-1.91
Total top 20	**284 059 418**	**296 791 000**	**310 116 000**	**4.48**	**4.49**

Source: UNCTAD secretariat, based on Dynamar B.V., June 2015, and various other sources.
Note: Singapore does not include the port of Jurong.

2.2 Maritime merchant transport

Currently, world shipping industry has a new maritime transport system that has been developed during the last 70 years. Within the pressures of the demand for different types of shipping service, foregoing system has evolved into three segments: bulk shipping, specialized shipping and liner shipping. In spite of these segments are closely connected, they have individual aspects of operations and different specializations. (Stopford 2009, 61).

In summary, in Figure 4 is illustrated the sea transport network differentiated into three shipping market segments.

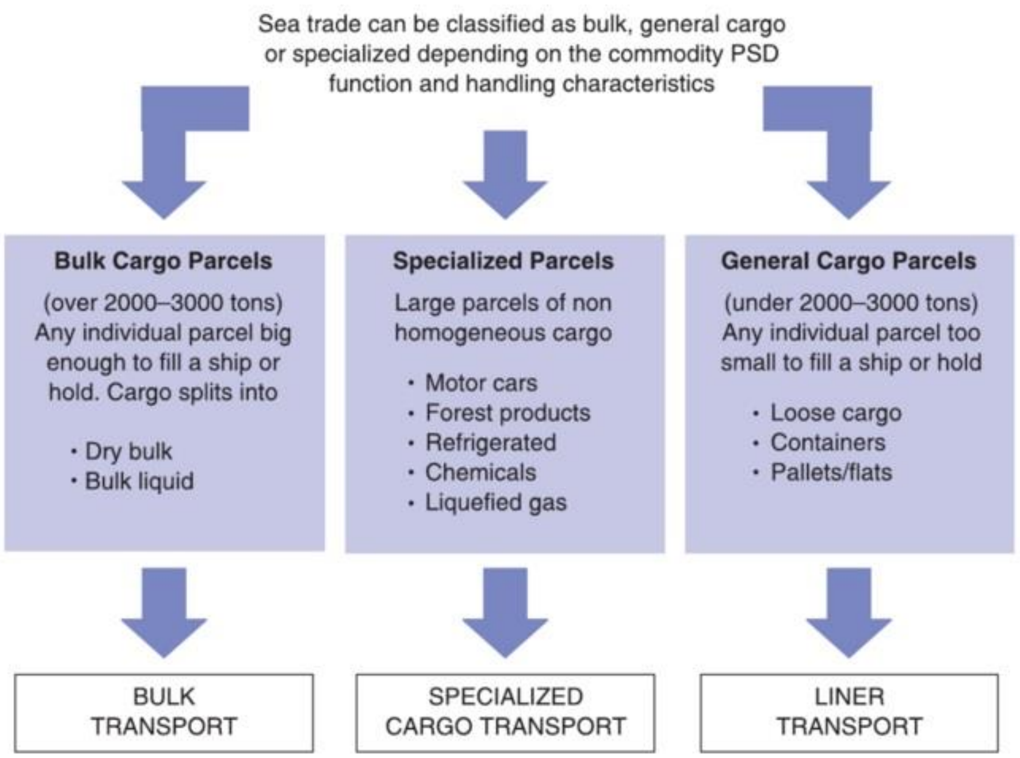


Figure 4. The sea transport network. (Stopford 2009, 61).

According to the represented diagram, the word sea trade was schematically divided into three streams: bulk cargo, specialized and general cargo transport. One should be noted that the shown structure does not imply “steadfast differentiation”. At present, many merchant ships are built for more than one purpose and might be transferred at times to complete another operation for cargo shipping. Examples of multi-purpose shipping are applied particularly in the oil transport markets the same as container shipping. In this manner, a tramp may be chartered for liner cargoes, whereas liners may be utilized for tramp with full or part cargoes. (Branch 2007, 50; Stopford 2009, 61; Wood 2002, 74)

2.3 Cargo types

All three mentioned segments of shipping execute the same functions: they transport a ‘commodity’ or cargoes in ships. In real word, because of different requirements about the type and level of shipping, cargoes are usually classified by their value and volume as with the number of transactions handled. (Stopford 2009, 63-64).

Bulk cargo is carried “on a ‘one ship, one cargo’ basis, generally using bulk vessels”. In this case, bulk vessels complete few transactions (about six voyages) with a single cargo each year. Bulk cargo is divided on the several groups:

- Liquid bulk such as crude oil, oil products, liquid chemicals requiring tanker transportation.

- The five major homogeneous bulks – iron ore, grain, coal, phosphates and bauxite carried by the conventional dry bulk or multi-purpose (MPP) vehicles.

- The most important minor bulk commodities as steel products, cement, sugar, salt, forest products and chemicals are transported in shiploads. (Stopford 2009, 64).

General cargo called ‘break-bulk’ or packaged is the other type of consignments that are often high-value and delicate and requiring a special shipping service. This cargo has small quantities for bulk shipment and is transported accordingly by liner vessels which make regularly schedule routes. The main general cargo types are as follows:

- Loose cargo, individual items, boxes, pieces of machinery handled and stowed separately.

- Containerized cargo became the general form of cargo transportation.

    - “Palletized cargo packed onto standard pallets, secured by straps or pallet stretch film for easy stacking and fast handling.

    - Pre-slung cargo, small items such as planks of wood lashed together into standardized packages.

    - Liquid cargo carried in deep tanks, liquid containers or drums.

    - Refrigerated cargo is goods that must be chilled or frozen, insulted holds or refrigerated containers”.

- “Heavy and awkward cargo, large and difficult to stow.” (Stopford 2009, 64-65).

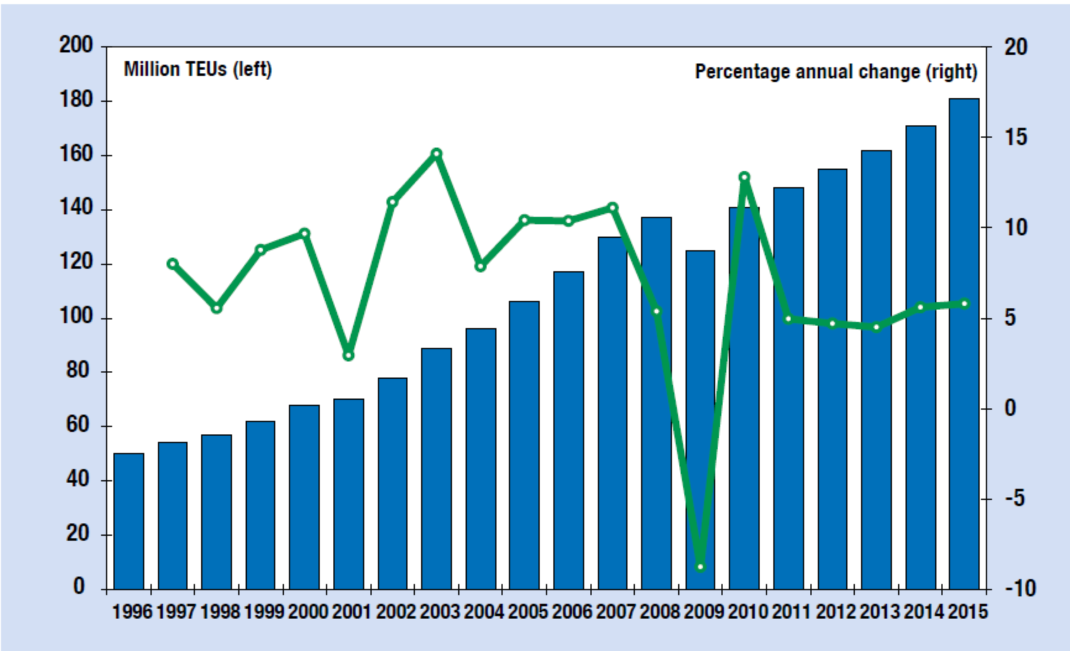
Basically, a common mode transporting this group of consignments is to package it firstly into a container. However, not all general cargo carried by liner service is containerized. (Wood 2002, 65-66).

Another class of cargo segment involved both characteristics of bulk and general cargo is *specialized cargo* such as motor cars, forest product, refrigerated cargo, chemicals and liquefied gas. These consignments have high-dimensions and are transported by the specialized shipping service that does not be implied “special” ship design. It stipulates specific shipping operation that should be adapted for complex transport performance. (Stopford 2009, 65-67).

To conclude the examined aspect, one should stress that it is difficult to divide neatly all commodity trades into the given categorisation. Thus, many small cargo groups such as a shipload of forest products classified as bulk cargo might be shipped partly in bulk and partly as general cargo. At the other manner, general cargo packaged into containers could be handled in bulk, whereas liner ships that are scheduled to sail may haul a partial load of oversize shipment known as “deck” cargo. (Stopford 2009, 90; Wood 2002, 67).

3 CONTAINERIZATION

The deep-sea containerization as a method of distributing of goods was established in the 1960s and still has dominated on maritime trade shipping over 50 million units cargo annually. This involves the movement of cargo in a unitized form thereby permitting to reduce the ship turnaround time in port and improves the cargo security. (Stopford 2009, 65; Emmett 2009, 27).



Source: UNCTAD secretariat, based on Drewry Shipping Consultants, Container Market Review and Forecast 2008/2009; and Clarksons Research, *Container Intelligence Monthly*, various issues.

Figure 5. Global containerized trade, 1996–2015 (million TEUs and percentage annual change). (Review of Maritime Transport 2015, 19).

Doubtless that the container business, accounting over 140 trading nations and more than 360 ports which handled 171 million TEUs (20 foot-long equivalent unit – container measurement) in 2014 (Figure 5), has been largely responsible for the globalization and it is entitled to special examination. (Branch 2007, 346; 487; Review of Maritime Transport 2015, 19).

3.1 Features of containerization

It should note the following features of containerization:

Two basic types of container Sea/Ocean Services:

— FCL (Full Container Load). “This is suitable for the shipper who has sufficient cargo to fill a complete container, or who prefer to load the container themselves.” (Emmett 2009, 27-28)

The carrier receives the container loaded and sealed beforehand at the shipper’s premises. At the port destination, the container might be delivered to the consignees’ premises where also can be unpack by themselves. (Emmett 2009, 27-28)

— LCL (Less than Container Load). “This service is most suitable for a shipper who does not have sufficient cargo to fill a complete container. (Emmett 2009, 27-28)

The container will be stowed by the carrier together with the cargo of other shippers. At the place of unloading, the relevant consignees pick up the cargo from the carrier’s the depot/warehouse. (Emmett 2009, 27-28).

According to Stuart Emmett, the four terms are applied for container transport:

- FCL/FCL: The container is packed by the shipper to be unpacked by the consignee.

- FCL/LCL: The container is packed by the shipper and will be unpacked by the carrier.

- LCL/FCL: The container is packed by the carrier and will be unpacked by the consignee.

- LCL/LCL: The container is both packed and unpacked by the carrier. (Emmett 2009, 28).

3.1.1 Advantages of containerization

- Containerized method provides a door-to-door service without intermediate process reducing the risk of cargo damage and pilferage.

- It allows stowing less packed or unpacked goods in the container itself. For instance, liquid or powder cargoes require no packing refrigerated tanks.

- Containerization has facilitated vessels' utilization with fleet improvement that is more productive than the 'tween-deck tonnage;

- Containerization eliminates warehouse accommodation needs reducing importers' working capital and "lessens risk of obsolescent stock" due to faster transportation usually with more reliable schedules;

- Containerization develops of computer unified system applying in many areas such as documentation processing, container control tracking, customer billing, and container stowage in the vessel. (Emmett 2009, 28; Branch 2007, 376-377).

3.1.2 Disadvantages of containerization

- "Not all cargo can be containerized". Special large and heavy commodities are be carried by the traditional break-bulk methods;

- Containerization requires capital investment and specific port terminal facilities. (Emmett 2009, 28; Branch 2007, 377-378).

3.2 Container types

According to International Standards Organization (ISO, an international body establishing international standards)specifications, basically the majority of containers are built up to 2.6 meters (8ft 6 inches) height, with 3 meters (9 ft 6 inches) height on some trades. “On length, some 45-foot containers are used on European trades and on the width, also in Europe it is not uncommon to find 2.5 meters (8.202 ft).” (Emmett 2009, 27).

Five of the most common types of shipping containers in use today are illustrated in Table 6 (Appendix 8). Additionally, their general characteristics and field of application are given below:

1) Standard container. “Designed to carry a wide variety general cargo. They are often labeled as dry containers because they carry dry goods either in break bulk (most common) or bulk (less common) form. Cargo is loaded and unloaded through a double door which marks the "back side" of the container”;

2) Open top container. “A container with a fixed roof and designed to carry cargo that is too large to be loaded through standard container doors. The container is loaded from the top with a tarpaulin used to cover its contents. The container is ideal for sheet glass, timber and machinery”;

3) Refrigerated container (reefer). “Container designed to carry temperature controlled cargo, often around or below freezing point. Each container is capable of being set at its own individual carriage temperature. They need to be connected to an electrical supply”;

4) Flat container. “Having an open roof and sides designed to carry heavy and oversized cargo. The cargo transported is left exposed to outdoor conditions. There are lashing points for strapping down the goods in transit”;

5) Tank container. “Designed to carry liquids (chemicals or foodstuff). This encloses a tank within a standard frame of similar dimensions to a standard container”. (Benson 1994, 205; Branch 2007, 361-370; Rodrigue & Slack 2013).

Every container should have a unique unit number, often called a box number, by which can identify who owns the container and even monitor its movement through the world. Additionally, for ensuring the high security of the container’s contents are applied container seals required with the international standard ISO 17712. Such seals not only guarantee a physical barrier to any attempted penetration, but also contain electronic data about the container on radio frequency identification (RFID) tag also known e-seals. On these electronic seals are recorded the temperature, humidity and light levels within the container which can be monitored by the sensors at different stages in the transportation system. (Branch 2007, 361-370; Mangan 2012, 22).

3.3 Principle of unit loading

To conclude the review of container types, one should describe how containerized cargo is loaded and stowed into a container. This essential information helps to maximize container capacity and space limitation for avoiding a problem with goods overflow. For increasing cargo handling efficiency, most shipping company are using a unit load concept – unitisation – that allows carrying items as a single unit. Such unit load is stored on a pallet, which is a wood or metal framework. (Benson 1994, 195-196).

There are many different sizes of pallets; however, the common-used are two types - europallet (120 cm x 80 cm) and standard, or American, pallets (120 cm x 100 cm). Table 4 (Appendix 5) demonstrates how many pallets might be fitted in two ranges of the container: 20-foot and 40-foot. It should be noted that pallets are stored in three tiers when loaded in the container. (Military Pallets, Boxes and Containers 2014; Benson 1994, 196-201; Website of Specific Freight 2006).

4 THE MARITIME TRANSPORT SYSTEM

In the second half of the twentieth century, the rapidly growing trade between the Far East and Europe created the necessary conditions for developing a new system for shipping of containerized cargo. To deal with these going reforms, "the shipping industry developed a sophisticated system of cargo liner services that provide fast, frequent and reliable transportation for almost any cargo to almost any foreign destination at a predictable charge". (Stopford 2009, 506).

4.1 Liner shipping services and main trade routes

Established at the end of the nineteenth century, liner services extending their network across the world "operated on regular schedules and were often designed for specific routes". The new trade strategy has required from the liner companies to refine their system and build more sophisticated cargo liner vessels with additional features and automated equipment. (Stopford 2009, 29-31; 507).

When containerization arrived in the 1960s, the complexity of the transport operations has increased that led to formation of absolutely new way of organizing transportation. Unitization general cargo using containers allowed liner companies to improve cargo-handling technology, automate the transport process, reduce transit times and raise productivity. Some researchers reasonable emphasize that "liner shipping companies are integral components of the global container shipping network, and their decisions and policies have large effects on the liner industry". (Chew, Lee & Tang 2011, 54; Stopford 2009, 29-31; 506-508).

Across the world, there are over 1000 existing maritime routes which minimize distance and time between the coastal regions. The main liner routes laid between the primary trade markets, Europe and East Asia, link the three European ports (e.g. Rotterdam, or Hamburg), and eight or nine ports in East Asia including Shanghai, Singapore and Pusan. Therefore, to provide a regular service in this field, the nine ships are departed direct to Japan, Korea, and to South East Asia weekly. The liners transit through the Suez Canal and the Strait of Gibraltar passing this distance within approximately 60 days. On this route, they tranship their respective cargoes at the hubs such as Singapore, Colombo or Suez. The duration between the mentioned ports in days is shown in Table 5. (Stopford 2009, 524; 528-529)

The major liner companies operated on this route are NYK, Hapag-Lloyd, MOL, OOCL, APL and MISC, and Maersk. In Table 6 are listed the leading liner shipping companies ranked by UNCTAD in accordance with per cent of market that they share. (Stopford 2009, 528).

Table 5. Duration between ports in days. (Stopford 2009, 529).

From/To	Rotterdam	Hamburg
Singapore	16	19
Shanghai	22	25
Pusan	24	27

Table 6. The leading liner companies, 1 May 2015 (Number of ships and total ship-board capacity deployed, ranked by TEU). (Review of Maritime Transport 2015, 39).

Rank	Operator	Market share % (TEU)	TEU	Vessels	Average vessel size	Orderbook TEU	Orderbook vessels	Average vessel size orderbook
1	Maersk Line A/S	13.45	2 526 490	478	5 286	91 080	9	10 120
2	Mediterranean Shipping Company (MSC) SA	13.22	2 483 979	451	5 508	498 680	36	13 852
3	CMA CGM S.A.	8.00	1 502 417	375	4 006	182 500	16	11 406
4	Evergreen Marine Corporation (Taiwan) Limited (Evergreen Line)	5.08	954 280	204	4 678	354 000	23	15 391
5	COSCO Container Lines Limited (COSCON)	4.55	854 171	158	5 406	119 500	10	11 950
6	China Shipping Container Lines Company Limited	4.00	751 507	136	5 526	19 100	1	19 100
7	Hapag-Lloyd Aktiengesellschaft	3.90	732 656	145	5 053	0	-	
8	Hanjin Shipping Company Limited	3.41	640 490	104	6 159	0	-	
9	Mitsui O.S.K. Lines Limited (MOL)	3.19	599 772	111	5 403	122 300	6	20 383
10	APL Limited	2.91	545 850	96	5 686	0	-	

The absolute leader of liner shipping services is Maersk Line having a share of 13,45 per cent of the world handling TEU's capacity. Although, the company has head-quarters in Copenhagen, also its subsidiaries are located almost in all ports around the globe. In the beginning of 2015, Maersk Line owning the great number of container shipping vessels, 478 ships with average size of almost 5 300 carried a total over 2,5 million TEU. Additionally, the commercial fleet of the liner operator contains the largest container ships of last generation currently operated in the world that will be illustrated in the follow part. Another liner company that is needed to point out for the further reference is CMA CGM which ranked the third place in the list. It is a French container operator based in Marseille. The company has a fleet of 375 vessels with a total capacity of over 1,5 million TEU that is operate at 400 ports in 160 countries around the world. (Branch 2007, 350-351; Review of Maritime Transport 2015, 37-39).

One should note concerning the given table, besides the top three liner operators that based in Europe, the most companies among the other top 10 controlling over 61 per cent of global container fleet are located in Asia. About half of the ships chartered by these carriers belong to shipowners from Germany or Greece, for instance. (Review of Maritime Transport 2015, 37-39)

4.2 Some key definitions

Before starting the review of vessels' types, primarily it needs to define methods of measurement of the ship's size that is important for further comprehension vessel's characteristics as well as the question of which ships transport which cargoes. Besides, this point also has vital commercial importance. Thus, ports apply the measure of the vessel tonnage for their pricing system and fees charging. (Stopford 2009, 751).

There are few basic terms of tonnage in use:

- Deadweight tonnage (dwt),the most frequently used by many trades for estimation of the cargo-carrying capacity, is the total tons of cargo including stores, fuel and other baggage a vessel can carry.

- Gross registered tonnage (grt) represents the internal volume of the ship and is surveyed in the first registration procedure. It is calculated in 100 cubic feet (2.83 m3) of capacity that is equivalent to one gross ton.

- Gross tonnage called as the "magic number" applies to vessels, not to cargo. It is determined the total enclosed volume of the ship in cubic metres. A vessel ton is 100 ft^3.

- Displacement tonnage is the total weight of water the ship displaces. There are indicated two weights of displacement – lightweight and standard, the difference between of which chiefly determines the deadweight tonnage.

- Suez and Panama canals have own systems of tonnage measurement for vessels transiting through these areas. (Branch 2007, 19-20; Stopford 2009, 751-754; Wood 2002, 70; Website of BIMCO Education 2016).

4.3 Merchant fleet by main cargo types

According to the report of United Nations Conference of Trade and Development (UNCTAD), at the beginning of 2015 year, the world fleet of merchant ships numbers nearly 90,000 vessels, with a total tonnage of 1.75 billion dwt. They are registered under national flags of 150 countries, and one of the largest ship-owner among them, Greece, has 16,11% of total deadweight tonnage in the world. The other twenty four largest ship-owning countries are listed in the Table 7 attached as Appendix 5. As it is noted in the report, five of the top ten countries are from Asia which four of them - China, Hong Kong, the Republic of Korea and Singapore -have advanced to the highest positions in the rating from 2005. (Review of Maritime Transport 2015, 29-36).

All world merchant vessels are mostly classified by the type of cargo they carry. In Figure 6 are presented the three groups of maritime vessels operating on the oceans: offshore oil and gas structures, cargo shipping and non-cargo ships. The centerpiece of this section, cargo ships are divided in more detail into four sectors related to economic activity - general cargo transport, dry bulk transport, oil and chemical transport, and liquid gas transport. At the last level of the ship type structure are categorized 19 segments of the fleet based on the physical design of the hull. (Wood 2002, 65; Stopford 2009, 569).

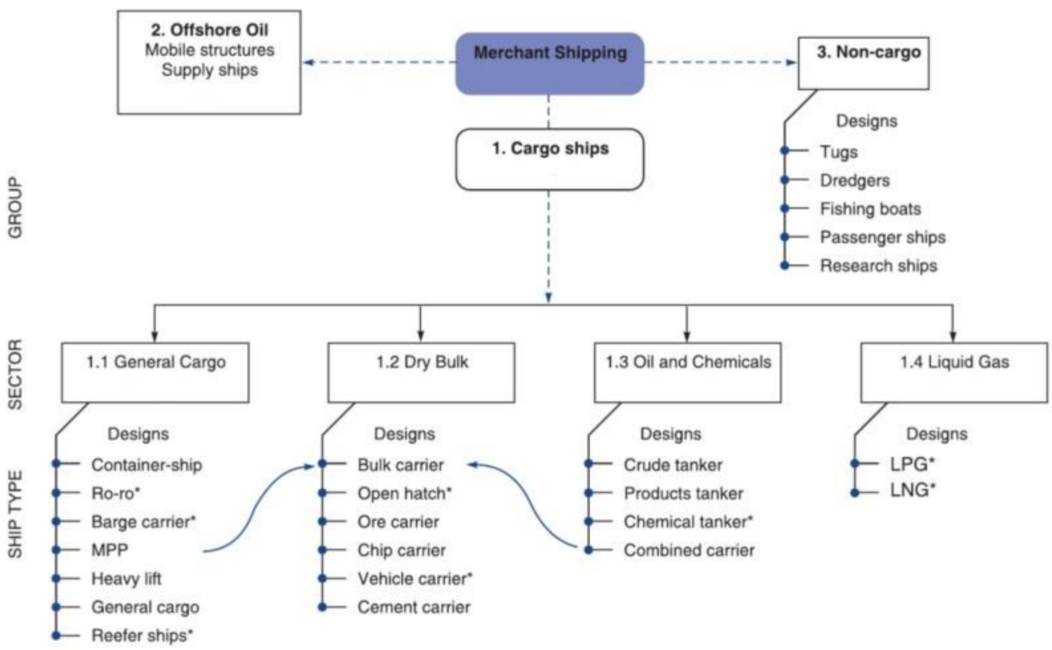


Figure 6. The shipping fleet by group, sector and ship type. (Stopford 2009, 569).

In spite that the depicted Figure6 seems to be well stated, there are no distinct determinations to which category a particular ship is placed. The reason of this circumstance is the meaning that the key position in shipping industry relates to the transported product, but not to a ship carrying the trade. Thus, when it needs to haul containers, the most profitable ship providing the transport could be used. Although it makes problem for shipping economists to collect trade statistics about cargo types, actualities of the current commercial word force shipping industry to deal of attention on the flexibility of vessels. (Stopford 2009, 67-68; 567; 580).

In other words, how many types of different commodities the vessel is able to carry how it is shown in Figure 7. There are the listed cargo units transported by the vessel in the left column and the types of considered ships in the right column. The lateral cargo mobility (LCM) rating making links between these two columns shows, in the

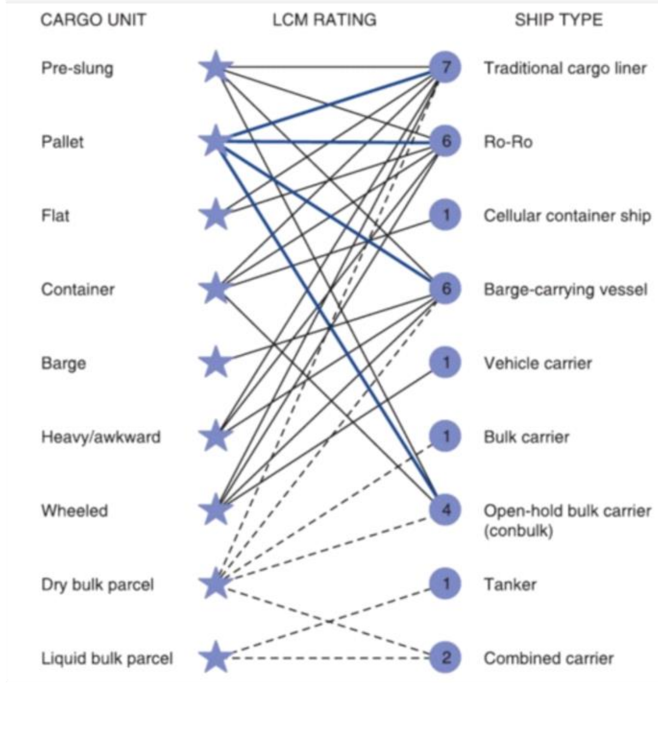


Figure 7. The flexibility of the ships. (Stopford 2009, 580)

first place, the coefficient of the flexibility of the vessel specialization, and, in the second place, outlines the ship designs which can carry various types of cargo. In this case, the higher number of the coefficient reflects the greater flexibility of the ship. (Stopford 2009, 67-68; 567; 580).

The descriptions of the primary types of merchant vessels that can carry containerized cargoes being the main focus of this research will be given in the further part. One should stress here that vessel types will not be considered in terms of general design characteristics merely in principal dimensions. (Stopford 2009, 67-68; 567; 580).

4.4 Merchant fleet for general cargo

Since the 1960s, the major liner companies have started to replace their commercial fleet with container-ships. Although this class of ships is currently playing a dominant role in liner trades, there are also several different vessels' types used in this sector. (Stopford 2009, 537; 581).

<u>Container-ships.</u>

In essence, these are cellular 'lift on, lift off' vessels with the open top. All these vessels are designed for the shipping of containers and have “cell guides so that containers can be dropped into place and held securely during the voyage without lashing”. (Stopford 2009, 537; 582).

One of the important characteristics applied for this category is 'generation' representing radical stages of the evolution in ships' technologies and sizes.

- Feeder and Feedermax. The container ships with the size of less than 1000 TEU are mainly used in the short-sea trades" or costal traffic.

- Handy. The medium-sized ship of 1000-1999 TEU serves by operations "where port restrictions or cargo volume do not permit the use of a larger vessel".

- Sub-Panamax, Panamax and post-Panamax. The bigger vessel over 3000 TEU used on long-haul trade routes allow faster transporting the largest volume of cargo. (Stopford 2009, 539; 582).

The four biggest container ships by cargo capacity with their illustrations are shown in Table 8 (Appendix 6).

Picture 1. Multipurpose Vessel / Tweendecker vessel. (Website of Shipspotting 2016)

Multi-purpose vessels.

The main advantage of MPP vessels (Picture 1) can transport a mix of containerized and break-bulk or other cargoes, for instance, heavy and awkward freights that cannot be stowed into a container. Although this type of ships has "a high degree of flexibility" which serves "a good operating efficiency", it needs to take into account that there are significant differences from traditional container-ship design including open three or five holds without cell guides and a removable 'tween deck. (Stopford 2009, 537; 586-588).

General cargo liners.

This is the oldest type of the general cargo fleet which handles mainly the mixed general cargo, tanks with liquid, refrigerated capacity, and small bulk parcels, and less containerized cargo. In spite of this fact, this “purpose-built cargo liners” still operate primarily on deep-sea routes. (Stopford 2009, 538; 589).

‘Tweendecker tramps.

The ‘tweendeckers are also the oldest type of the fleet contain and represent “simple version of the cargo liner types”. Due to “containerization of general cargo, they being replaced by MPP vessels” are still used for shipping a mix or general and bulk cargoes in some trade (Picture 1). (Stopford 2009, 537; 589).

Ro-ro ships.

It is a “flexible alternative for transporting a mix of containerized and wheeled cargo”. An undoubted plus of this type is fast port loading and unloading due to roll-on “access ramps, open deck allowing fast maneuvering of fork-lift trucks”. Also its design has good access between decks which is easy to handle any cargo such as pallets, bales, containers or wheeled cargo (Picture 2). (Stopford 2009, 538; 585-586)

Picture 2. Ro-ro vessel. (Website of Shipspotting 2016)

Refrigerated vessels

Refrigerated vessels (or reefers) (Picture 3) are designed to carry frozen or chilled cargo for which the temperature is controlled during the transportation. They may also accommodate reefer containers “on deck or in the holds plus conventional container capacity”. (Stopford 2009, 590).

Picture 3. Refrigerated vessel. (Website of Shipspotting 2016)

5 CONTAINER PORT TERMINALS

5.1 The role of ports in the transport system

Ports are the significant element in the container transportation system. In this concept, ports are considered not only as ‘a gateway for trade’ on the national level, but also as the important link in the transport logistics chain between ships and industrial hinterlands. Today, the modern port is primarily a place where the world’s trade activity takes place. (Branch 2007, 382; Stopford 2009, 81).

In the beginning of 21st century, a result of the boom in international trade has generated the growth of container traffic focusing mainly on the imports and exports between Far East and countries in Europe and North America. With this globalization of production and consumption, it was a natural consequence that the container-shipping and port industries have had to respond accordingly. (Branch 2007, 359-361).

Over the years, many of today’s major ports in North- and Southeast Asia have improved their container cargo-handling services to conform the trends of global trade growth. To increase their attraction and competitive positions, the ports have done a lot for upgrading their infrastructures, container-handling capacity and operations. (Branch 2007, 213).

At the following parts, it is given the examination of the three largest shipping container ports – Shanghai, Busan and Singapore – which have evolved “their traditional local function” to the level of the international shipping centers in East Asia. Definitely, it is important for decision-making to explore the appropriate port terminal areas including necessary cargo-handling equipment and the existing location of warehouses. (Rodrigue & Slack 2003).

5.1.1 Some basic definitions

The first issues that should be defined for the further consideration in this chapter are "port", "port authority" and "terminal".

First of all, a port is literally identified as a geographical area located usually on a bay or river mouth. Thus, the major megaport in the Europe, the Port of Rotterdam, is situated in the Netherlands at the mouth of the river Rhine that faces towards the North Sea. Such location favorably distinguishes the port from other competitors in the world. (Stopford 2009, 81; Rodrigue & Slack 2003; Website of the Port of Rotterdam Authority 2016).

A port area provides berth facilities for vessels involving in the transportation process. However, apart from the major function of a port "to supply services to freight (warehousing, transshipment, etc.) and ships (piers, refueling, repairs, etc.)", it is also denoted following features:

Physical capacity features:

— sea and land access;
— infrastructures for ships berthing,
— road and rail network;
— industrial area management. (Alderton 2005, 24; Stopford 2009, 81)

Control functions:

— vehicles, all modes, entering and leaving the port;
— control of dangerous cargo;
— safety and security within the port area;
— environmental, immigration, health, customs and commercial documentary control. (Alderton 2005, 24; Stopford 2009, 81)

Specific performances:

— pilotage, tugging and mooring activities;

— use of berths, sheds, etc.;

— loading, discharging, storage and distribution of cargo. (Alderton 2005, 24; Stopford 2009, 81).

Thereafter, the port authority has administrative functions which are responsible for the regular maritime services and commercial operations. This organization may belong to the state or local government or private companies. For instance, the Port of Rotterdam is operated by the Port of Rotterdam Authority which is responsible not only for the shipping traffic, but also for commercial development and daily port duties as well as for long-term development including strategic planning and research. (Alderton 2005, 385; Stopford 2009, 81; Website of the Port of Rotterdam Authority 2016).

Finally, a terminal might be described as a central and intermediate location required specific facilities and equipment to handle a particular type of cargo. Terminals are managed by the port authority or leased by a port operator for its specialized purposes. (Stopford 2009, 81).

On the point of key elements of a maritime container terminal may be emphasized as follows:

- Docking area. A place contains berths that have standard post-panamax specifications for containerships about 325 meters of length and a draft of about 45 feet (13 meters).

- Container crane (Portainer). A modern container crane is required to have a 18-20 wide coverage to carry containers with a width of 18 to 20. The larger number of cranes provides the faster process of cargo handling.

- Loading / unloading area. In general, it is a zone where containers are loaded on the containership or unloaded for storage or movement for further distribution.

- Container storage. A temporary buffer zone designated for the stowage of containers for export and import stacks. Commonly, the high cargo throughput requires the wide storage area. In this configuration, containers are piled up to 3 units in height while empty containers can be stacked up to 7 or 8 containers in height at the separate terminal's area.

- Administration. At the territory of terminal is located a control tower for visual monitoring and management of the whole terminal performance. (Rodrigue & Slack 2003).

Additionally, multipurpose distribution centers and large retailers, empty container storage areas and logistics companies concentrate basically near the operation zones of container terminals. (Rodrigue & Slack 2003).

Picture 4. Rotterdam Multimodal Container Terminal. (Website of Dredging Today 2016)

In Picture 4 is represented the multipurpose container terminals in the Port of Rotterdam which is recognized as the most advanced terminals in the world. The terminals are equipped state-of-the-art facilities and the largest cranes. The automated terminals with "extremely high handling capacities" can deal with large container ships with tonnage of more than 19,000 TEU. (Website of the Port of Rotterdam Authority 2016).

5.1.2 The factors affecting shipping companies' port choice

In the modern global maritime industry, there is a high level of the competition among container terminals at the same port as well as between ports at the same region. This competitive environment motivates to improve the port services and infrastructure that tend to attract port users. In these conditions, it is very important to analyze the causes of the shippers' choice for the development of existing port terminals. (Branch 2007, 393).

In academic literatures, there is no concrete specification determining the key factors in port selection since this selection might be based on peculiar reasons of a company. However, the core criteria that affect port terminal's choice most strongly can be mentioned such as port cost, geographical location, quality of hinterland connections, productivity and capacity. The analysis all of these aspects requires their individual research. Hence, in this part will be represented those which specifically concern only to the container handling. (Cullinane & Song 2007, 36).

Undoubtedly, the prioritized criteria are surely related to operating costs, port tariffs and other local taxes charged in a particular port that become a basis of any logistics plan. Furthermore, the following factors are rather important:

a) Geographical location. The port terminal has strategic advantages not only in the point of a position near main shipping routes, but also in terms of the convenient water access to and from the hub that might surely increase transit time. (Branch 2007, 393)

An example is the Port of Rotterdam located directly in the natural deep-water harbour of the North Sea has strong advantageous that ensures navigational safety for vessel movements. (Branch 2007, 399-400)

b) Ships' specification that the port can accommodate is determined by drought, bean, length and capacity. (Branch 2007, 393)

Thus, the Port of Rotterdam has the standard water depth is 75 ft which gives it an ability to accommodate large container vessels with different technical characteristics. (Branch 2007, 399-400)

c) The level of container traffic including “ship-bound” and “land-bound” flows. In this manner, availability of the free trade zone (FTZ) located at the port side is a significant factor in port selection which reduces time of cargo transhipment. (Branch 2007, 393-394)

Rotterdam is related to the major transhipment port in the world handling more than 12 million TEU annually. Directly near to the container terminals are situated three large-scale business parks, Distriparks, providing warehousing and ‘value adding’ logistics services such as repackaging, labeling, assembly and quality control. (Branch 2007, 399-400)

d) The level of hinterland infrastructure including rail, road and inland waterway system. (Branch 2007, 394)

The Port of Rotterdam, for instance, has “six competitive hinterland modalities – road, rail, barge, pipelines, air and short sea/feeder”. Also situated on the rivers Rhine and Meuse, the port is involved to extensive inland waterway systems connecting Germany, Belgium, France; Switzerland and Austria. Finally, supported by the advanced European rail transport, and providing “a dedicated freight railway line between Rotterdam and Germany”. (Branch 2007, 399-400)

e) The quality of the port management characterized by “the degree of understanding between port users and the management team” is also important factor. (Branch 2007, 394)

Thus, the Port of Rotterdam Authority, customs and the port business community represent “a port-wide community system” that allowed “optimizing logistics and raising the level of customer service”. (Branch 2007, 399-400)

f) The significant factor is the technological level of port operations such computerized facilities that enable to control safety ship traffic in all weather conditions. (Branch 2007, 394-395)

It is mentioned that Rotterdam port developed a unique Vessel Traffic Management Information System to control shipping traffic continuously from 60 km from the coastline to the port areas. (Branch 2007, 399-400)

Additionally, supporting port services such as ship repair facilities, container servicing, cleansing and repair facilities, maintenance of cargo handling equipment, security resources, and medical facilities also determine the choice of port terminal. (Branch 2007, 393-396).

5.2 Shanghai

Currently, the Port of Shanghai is reasonably called the one of the busiest shipping container ports in the region. Being “the important gateway of China’s trade”, the port achieved a container throughput of 35,29 million TEU in 2014 (Table 2). This has allowed Shanghai to reach the rank of first positions in the world's top container handling ports. (Review of Maritime Transport 2015, 15; Li 2003, 1)

Originally, Shanghai was playing a role of an all-round hub based for serving a transhipment point between manufacturing industries along the Valley of Changjiang River (Yangtze) and China’s coastal cities. Since the 1990s, the Shanghai Municipal Government has undertaken the ambitious ‘Yangshan project’ related to the foundation of the Shanghai International Shipping Center (SISC), and included the reconstruction container terminals which contain more maritime activities by the competitive advantage for foreign traders. (Cullinane & Song 2007, 60; 183).

After the re-organization of Shanghai Port Authority in 2003, the port has managed by the Shanghai International Port Group representing the sole operator of the public terminals. On that account, SIPG responds to following functions:

- handling cargo;
- transporting domestic and international cargo by land and water;
- de-stuffing, maintaining, manufacturing, and leasing containers;
- managing information on warehousing, processing, distribution, and port logistics;
- providing facilities for international passengers;
- piloting and towing vessels, and forwarding freight;
- providing in-port services;
- leasing port equipment and facilities; and building, managing, and operating port and terminal facilities. (Leslie 2015; Website of World Port Source 2016).

5.2.1 Geographical features and infrastructure

It is undeniable that the Port of Shanghai has an “advantageous geographical position”. It is located at the mouth of the Yangtze River with a total length of 18000 km along China's southeastern coastline. Geographically, the port has links between the inland waterways of Jiangsu, Zhejiang and Anhui provinces and the Yangtze River, thereby reaching the direct entry towards the East China Sea (Picture 5). Due to the mentioned natural conditions, the convenient transport connection through the valley of the Yangtze River and developed hinterland infrastructure, Shanghai port has become an ideal spot for handling international shipping transportation. (Website of Asia Trade Hub 2016; Website of World Port Source 2016).

The territory of the Port of Shanghai covers a total area of 3 619,6 km² that includes 125 berths over a quay’s length of around 20 kilometers, with 82 of them being able to accommodate vessels 8000 dwt class. Presently, the deepwater section of the port complex has a 3 000 m-long deepwater quay length, 34 state-of-the-art container quay cranes, 120 RTGs and different handling and transportation facilities. Moreover, there are a total of 293 thousand square meters of warehouses, over 4.7 million square meters of storage yards and 5143 units of cargo-handling equipment. Shanghai Port works 24 hours a day, seven days a week. (Leslie 2015; Port Profile: Shanghai 2011; Website of World Port Source 2016).

5.2.2 Container terminal areas

In substance, an appellation indicated as ‘the Port of Shanghai’ is a complex of different harbor zones serving defined shipping functions and includes three main container terminals areas: Wusongkou, Waigaoqiao and Yangshan (Picture 5). (Website of World Port Source 2016; Website of Shanghai International Port (Group) Co.,Ltd.).

Picture 5. The main container terminals at the Port of Shanghai. (Elliotlever 2016).

<u>Wusongkou Container Port Area</u>

The oldest harbour zone, Wusong Container Port Area, located at the estuary of the Huangpu River was developed in the 1980s. (Website of Asia Trade Hub 2016).

Container Port Area activities mainly:

- used for domestic container vessels;
- accommodate the operation of ships running on short-sea liner services. (Website of Shanghai International Port (Group) Co.,Ltd. 2016).

Facilities:

- 10 specialized container berths with a total quay length of 2 281m,
- berths are equipped with 20 gantry cranes
- container yards with a total area of 550 000m²,
- including container cleaning and management, storage and transport, inland goods storage and electronic data interchange. (Website of Shanghai International Port (Group) Co.,Ltd. 2016).

Port Area infrastructure consists of:

- Zhanghuabang Terminal,
- Jungong Road Terminal and
- Baoshan Terminal. (Website of Asia Trade Hub 2016).

Principal operators:

- Shanghai Container Terminals Company (SCT),
- Hutchison Port Holdings Limited (HPH) and
- SIPG.(Website of Asia Trade Hub 2016).

<u>Waigaoqiao Container Port Area</u>

Besides the 'Yangshan project' started in 2002, the first plan with the approval from the China's State Council concerning the foundation of free trade zone was the Waigaoqiao terminal project. During the period from 1997 to 2003, the project was divided on the five phases which have provided a total of 16 container berths after the realization of the construction. The Waigaoqiao's warehouse area is the largest in this sector covering in total of 78 852m². (Website of Asia Trade Hub 2016; Website of Kintetsu World Express, Inc. 2016).

Container Port Area activities focus mainly on:

- international trade and logistics with shipping transportation from Southeast Asia, Japan and South Korea, Australia, West US, Middle East etc. trade lanes;

- most of the deep-sea liner services and some of the short-sea services. (Website of Kintetsu World Express, Inc. 2016).

Principal operators:

1) Shanghai Pudong International Container Terminals is described as high technological developed and innovative terminal at the Port of Shanghai with a total exploited land area of 500 000 m². It has a container yard with 8200 flat container slots which allows piling up 30 000 TEUs. The zone is managed by the Shanghai Waigaoqiao Free Trade Zone Stevedoring Company, Hutchison Ports Pudong Limited, COSCO Pacific (China) Investments Limited, and COSCO Ports (Pudong) Limited. (Website of Asia Trade Hub 2016; Website of Shanghai Pudong International Terminal 2016).

The principal facilities:

- 147 container handling equipment and machinery,
- 36 RTGs, ten quay cranes, 73 container trucks and 11 forklifts. (Website of Shanghai Pudong International Terminal 2016).

2) As the first full container terminal, the SIPG Zhendong Container Terminal Branch was launched in 2000 and totally owed by SIPG. It operates in a 1 659000 m^2 land area and has a total of 1566 meters of quays in five container berths.(Website of Asia Trade Hub 2016; Website of SIPG Zhendong Branch 2016).

The principal facilities:

- 71 RTGs, 22 quay cranes, 131 container trucks and 31 forklifts,
- including other world-class technological equipment and information management systems. (Website of SIPG ZhendongBranch 2016).

3) The Port of Shanghai's East Container Terminal Company Limited in the Waigaoqiao Area was established in 2002 by SIPG and APMT Terminals. (Website

of Asia Trade Hub 2016; Website of Shanghai International Port (Group) Co.,Ltd. 2016).

It spreads out on the land area over 1 550 000 m^2 and has a total quay length of 1 250 meters including four container berths for the main services and other two for the inland feeder services. The principal facilities consist of 13 quay cranes and 48 RTGs. (Website of Shanghai International Port (Group) Co.,Ltd. 2016).

4) Shanghai Mingdong Container Terminals Limited situated at the mouth of the Yangtze River was opened by SIPG and Hutchison in 2005 that have shared a 50-50 joint venture. Features of the location allow providing the navigation for vessels of 50 000 dwt. The principal facilities are represented in Table 9. (Website of Shanghai International Port (Group) Co.,Ltd. 2016; Website of Hutchison Whampoa Ltd. 2016).

Table 9. The principal facilities of the Port of Shanghai's East Container Terminal. (Website of Shanghai International Port (Group) Co.,Ltd. 2016; Website of Hutchison Whampoa Ltd. 2016).

Total area:	1,63 million square metres
Container berths:	4 deep-water berths (1,110 metres)
Super Post-Panamax quay cranes:	12 (one of them has a 40' twin-lift spreader, capable of lifting 80 tonnes)
Barge berths:	2 feeder berths (190 metres)
Specialised quay cranes for barge:	2
RTGC:	48 (two of which have a lifting capability of 60 tonnes)
Stacking capacity:	24 649 TEU
Other:	Facilities for reefer plugs, dangerous goods and container freight station (CFS)

Yangshan Port Area

Yangshan is a newest area of the Port of Shanghai and the first of deep-water container terminal in the country. Launched in December 2005 by the State Council, ‘Yangshan project’ was designed as a free trade zone under the custom’s control and “a high-standard shipping and logistics service center with special policies for container international transfer and export processing”. (Wang 2013, 32; Website of Asia Trade Hub 2016).

The Yangshan Port Area is located on the operation area of 8,14 km^2 at the entry of the East China Sea and managed by the Shanghai Shengdong International Container Terminal Company that is a subsidiary of SIPG. The important statistics of the terminal are represented in Table 10. (Website of FTZ-Shanghai 2016).

Table 10. The principal facilities of the Yangshan Container Terminal. (Website of Shanghai International Port (Group) 2016; Website of Asia Trade Hub 2016).

Area	Sea-side : 3 167 000 m^2, Land-side area : 1 340 000 m^2, Container yard area : 860 000 m^2
Facilities	- 5 berths, with a total quay length of 1600 m - quay side water depth of 16 m - 3000-meter-long deep-water quay, - 34 of the world's most modern container quay cranes, - 120 RTGs, - including additional handling and transportation equipment
Port activities	mainly deals with vessels serving trades to/from - Europe, - Mediterranean, - East US, - South America, - Africa etc.

5.2.3 Container Liner Services

Nowadays, regular container liner services calling at the Port of Shanghai connect it to the major ports in about 160countries. The shipping companies supply more than 2,000 container ships every month on the fix schedules and serve the top 20 international shipping lines including the routes to North America, Europe, the Mediterranean, Persian Gulf, Red Sea, Black Sea, Africa, Australia, Southeast Asia, Northeast Asia, and other regions. (Website of Cargo from China Ltd. 2016; Website of Shanghai International Port (Group) Co.,Ltd. 2016).

The leading container carries calling in the Port of Shanghai might be mentioned such as Maersk, OOCL, APL, China Shipping, Hanjin, MOL, CMA CGM, Evergreen. (Report on the Ports of Shanghai 2002).

5.2.4 Conclusion

With the rapid growth of container traffic coming into and leaving China, the port has faced challenges by handling increased cargo volume and container throughput. The difficulty has driven by the specific factors such as the lack of adequate container-handling facilities many of which are old and require of upgrading. Additionally, the port has its limited depth and insufficient berths preventing to accommodate container ships of 6000 TEUs. (Cullinane & Song 2007, 11-13; 16-17).

In order to resolve properly these uncompetitive conditions, the Shanghai Municipal Government had undertaken a series of reforms to attract foreign investments in the development of the port's harbour zones. The new projects have a number of stages including the construction of deep-container terminals at Yangshan in short period of time and foundation an international shipping center. According to a statement of vice president of port operator SIPG, Yan Jun, "Shanghai Port is a key part of the central government's national development plans. … We want to improve Yangshan as an international shipping center. And at the same time, improve our logistics services so that our clients can make better use of our port and to serve their business needs worldwide." (Wang 2013, 33).

Obviously, the appreciable improvements in the port's infrastructure have increased the attraction of the Port of Shanghai for foreign shipping lines and agencies. However, there are still poor natural conditions that restrict an access for the last generation of the container vessels to the terminals. Today, large ships such as 8 000 TEU "must wait for high tides to enter or leave Shanghai port" or, as an alternative, use the Port of Ningbo as a transshipment spot. The Ningbo port located only about 150 kilometers south of the Port of Shanghai has container-handling facilities that can support container vessels with capacity for more than ten thousand TEUs. Being "the second largest port in region”, it may replace Shanghai on the position’s range in the future. (Cullinane & Song 2007, 183-196; Website of World Port Source 2016).

5.3 Busan

The second port chosen for the research is the Port of Busan in South Korea. This decision is based on well-known circumstances that called by some authors as an “Asian economic miracle”. Over the last 25 years, the South Korea’s economic development has rapidly risen when seaborne trade has been also growing especially in the sector of container cargo shipment. Geographically located close to the two of the world’s large economies, Japan and China, South Korea handles large amounts of transhipment cargoes to and from these countries. (Cullinane & Song 2007, 34-40).

As a result, the Port of Busan situated on the important international arterial routes has become the one of the large ports in the world. It handled 18,678 million TEUs of container cargo in 2014 (Table 2) and became the sixth highest annual cargo port in the word’s rating. More than 67 per cent of this volume was container cargoes for export and import of Chinese markets. Besides, the Busan port transhipped about 50 per cent of cargoes transferred to or from Japan. (Cullinane & Song 2007, 34-40; Review of Maritime Transport 2015, 15).

Hereby, the Port of Busan has stable partnerships with such ports:

- in Japan: Yokohama, Kobe, Osaka, Nagoya, Tokyo and Hakata;
- in northern China: Shanghai, Qingdao, Tianjin and Dalian. (Cullinane & Song 2007,36).

The administrative and ownership structure of the Busan port contains such organizations as:

- the Busan Regional Maritime Affairs and Fisheries Office,
- the Korea Container Terminal Authority (KCTA),
- terminal operating companies and

- the Busan Port Authority (BPA). (Cullinane & Song 2007,37).

5.3.1 Geographical features and infrastructure

The Port of Busan is located on the southeast cost of the Korean peninsula at the mouth of the Naktong River. It is a natural deep-water harbour with 15~17-metres depths that serves the last generation of container vessels such as CMA CGM's 16 020 TEU container ship. Strategically, the Busan port is situated in a manufacturing area of South Korea about 400 km from the capital, Seoul, and mostly focuses on the container cargo handling. The port's area accounts over than 240 km^3 with a length of coastline about 202 km (Picture 6). (Website of Busan Port Authority 2016).

The port of Busan consists of 5 ports including six container terminals with 26,8 km of quay wall that allow to berth 169 vessels in the same time:

– South Port for domestic trade and passenger traffic;
– Busan New Port for international trade;
– North Port,
– Gamcheon Port and
– Dadaepo Port.

(Website of Ship-Technology (Projects) 2016).

Picture 6. The Port of Busan. (Kwon 2014).

5.3.2 Container terminal areas

The mentioned six container terminals are situated mainly at North Port's zone and have a variety of specialized handling and transportation facilities. (Website of Busan Port Authority 2016).

The significant statistics of the container terminals at the Busan port are summarized below in Table 11.

Table 11. Statistics of Busan container terminals. (Website of Busan Port Authority 2016).

Berth	Gamman International Terminal	Sinseondae Container Terminal	Jaseongdae Container Terminal	Singamman Container Terminal	Uam Container Terminal	Gamcheon Container Terminals
Quay length (m)	1 400	1 200	1 447	826.5	500	600
Water depth (m)	15	14-15	12.5-15	12-15	11	13
Capacity of cargo handling (10,000 TEU)	120	120	120	65	27	34
Capacity of berth-ing (10,000 ton/ships)	5/4	5/4	5/4 1/1	5/2 5/1	2/1 0.5/2	5/2

<u>North Harbour Area</u>

The North Port consists of five container terminals as follows (Picture 7):

- Port of BusanGamman Container Terminal
- Port of BusanShinsundae Container Terminal
- Port of BusanJaseongdae Container Terminal
- Port of BusanSingamman Container Terminal

- Port of BusanUam Container Terminal. (Website of Busan Port Authority 2016).

Picture 7. Busan North Port. (Website of Busan Port Authority 2016).

— Port of Busan Gamman Container Terminal

Gamman Container Terminal launched in 1998 covers about 730 000 m^2 of the operated area. It has the capacity to handle over 1,5 million TEUs each year including "state-of-the-art container-handling" equipment. Managed by Busan International Terminal Co., Ltd. (BIT), the port mostly performs activities including container handling, container "Maintenance and Repair" services, and CFS (LCL cargo, consol cargo-work, and etc.). (Website of Hanjin Shipping Co. Ltd. 2016; Website of Ship-Technology (Projects) 2016; Website of World Port Source 2016).

Principal facilities:

- 1,4 kilometers of quays
- 15 m of water depth

- berthing capacity for four 50 000 ton vessels. (Website of Hanjin Shipping Co. Ltd. 2016; Website of World Port Source 2016).

Principal operators:

- Korea Express Company Limited,
- Hanjin Shipping Company Limited,
- Global Enterprise Company Limited, and
- Hutchison Korea Company Limited. (Website of World Port Source 2016).

— Port of Busan Shinsundae Container Terminal

The largest container terminal of the Busan port also located at North Port's zone, the Shinsundae/ Sinseondae Container Terminal (or the Pusan East Container Terminal), was opened in 1991. It is managed by CJ Korea Express Busan Container Terminal Co., Ltd. and covers a total of over one million square meters. (Website of CJ KBCT 2016; Website of World Port Source 2016).

Principal facilities:

- 1,5 kilometers of quays;
- 15~16 m of water depth;
- berthing capacity for four 50 000 ton vessels;
- 42 347 m³ of yard space and 10 033 m³ of warehouse space
- including advanced loading / unloading equipment such as high speed container cranes capable of handling post-Panamax container ships. (Website of CJ KBCT 2016; Website of World Port Source 2016).

Port activities

- Container Stevedoring
- Transporter Intermediate service
- Cost-effective ON-DOCK Service
- CFS(Container Freight Station)

- Reefer Container Capacity
- Railway Facility. (Website of CJ KBCT 2016).

— Port of Busan Jaseongdae Container Terminal

The construction of Jaseongdae Container Terminal was started in 1974 under the Busan Port Comprehensive Development Plan at the North harbour. It covers a total land area of 624 000 m^2 including a container yard with the capacity of 44681 TEU and two CFS with the total area of 19750 m. The terminal is managed by Hutchison Korea Terminals (HKT), a member of Hutchison Port Holdings Limited (HPH), which has operated at the Port of Busan since 2002. (Website of Hutchison Korea Terminals 2016).

Principal facilities:

- about 1,5 kilometers of quays;
- 15 m of water depth;
- berthing capacity for four 50 000 ton class vessels;
- one 10000 ton class feeder vessel;
- including advanced loading / unloading equipment such as gantry cranes, e-RTGC and yard tractor, etc. (Website of Hutchison Korea Terminals 2016; Website of Busan Port Authority 2016).

— Port of Busan Singamman Container Terminal

Dongbu Pusan Container Terminal Company Limited, a joint venture between Dongbu Corporation (shareholding of 65%) and Evergreen (15%), operates at the Singamman Container Terminal in North port’s zone since 2002. The terminal covers a total of 308 000 m^2 that includes 153490 m^2 of a container yard and 5000 m^2 of CFS. (Website of Dongbu Express 2016).

Principal facilities:

- 826 meters of quays;
- 15 m of water depth;

- berthing capacity for two 50 000 ton class vessels;
- one 5 000 ton class vessel;
- including different loading / unloading equipment. (Website of Dongbu Express 2016; Website of Busan Port Authority 2016).

— Port of Busan Uam Container Terminal

The last from the five container terminals located at the North Area of Busan port is UAM piers that operated by UCT Container Terminal Ltd., Co. It has the small size of the operated area that amounts only 182 km^2 and pier length 500 m. (Website of U-am Terminal Co. Ltd. 2016;Website of Busan Port Authority 2016).

Port activities

- cargo handling,
- customs brokers,
- depots & terminals,
- stevedoring;
- storage, warehousing, distribution. (Website of U-am Terminal Co. Ltd. 2016; Website of Busan Port Authority 2016).

Gamcheon Harbour

In its essence, Gamcheon is multi-purpose operational port area with own ship repair yard and serves mainly deep-sea fishing ships and general cargo vessels. (Website of Busan Port Authority 2016; Website of World Port Source 2016).

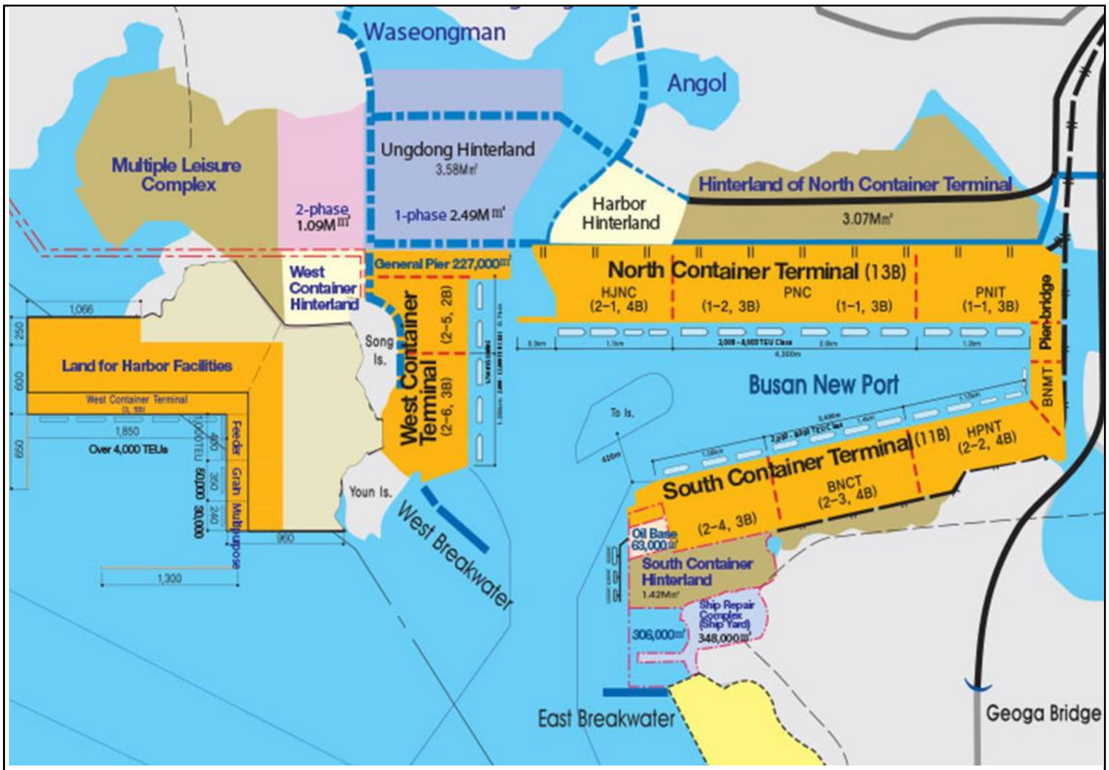
— Port of Busan Gamcheon Container Terminal

However, as a result of the increased container traffic transhipped throughout the Busan port, an additional container terminal built up at Gamcheon Port's area was opened in 1997 to support the North Port. (Website of World Port Source 2016).

Since 1998, the Port of Busan Gamcheon Container Terminal has operated by Hanjin Shipping Company Ltd, Co. It is situated at the territory of a total 148 000 m^2 with a volume of 340 000 TEUs of cargo per year. (Website of World Port Source 2016).

Principal facilities:

- 600 meters of quays;
- berthing capacity for two 50 000 ton vessels. (Website of World Port Source 2016).



Picture 8. The Busan New Port. (Website of Busan Port Authority 2016)

<u>Busan New Port</u>

In 1997, the Korean Ministry of Marine and Fisheries (MOMAF) announced the launch of a long-term construction project of new container terminals on Gudak Island located 25 km west of Busan North Port. According to this project designed to be completed in 2020, the Busan New Port "will be equipped with advanced operational facilities to provide quality services to customers". The sequence of project has been divided into two core phases and one additional phase which are associated with the north, south, and west container terminal area (Picture 8). By 2018, the port's government plans to finish the Phase 2-4. At the present time, the Busan New Port, started its operations in 2006, has 23 berths with water depth of over 17 m that allows accommodating vessels of 19 000 TEU and handling over 10 million TEU of cargo annually. (Website of World Port Source 2016; Website of Ship-Technology (Projects) 2016; Website of Busan Port Authority 2016).

Port facilities:

In Table 12 are summarized the principal facilities with which the container terminals are equipped.

Table 12. Busan New Port's principal facilities. (Website of Busan Port Authority 2016)

	Busan New Port (Phase 1-1)	Busan New Port (Phase 1-2)	Busan New Port (Phase 2-1)	Busan New Port (Phase 2-2)	Busan New Port (Phase 2-3)
Total space (m^2)	840	1,210	688	553	785
Pier length (m)	1,200	2,000	1,100	1,150	1,400
Berthing capacity	50,000ton × 3	50,000ton × 6	50,000ton × 2 20,000ton × 2	50,000ton × 2 20,000ton × 2	50,000ton × 4
Annual handling capacity (million TEU)	1,38	2,73	1,6	1,6	1,920
Front depth of water (m)	16	16~17	18	16~17	17
Year opened	Jan. 2006	Jan. 2006	Feb. 2009	2010.2	2012.1
Managing company	Pusan Newport International Terminal (PNIT)	Pusan New Port Company (PNC)	Hanjin Shipping Co., Ltd.	Hyundai Merchant Marine Co., Ltd.	Busan Newport Container Terminal Co. Ltd(BNCT)

5.3.3 Container Liner Services

Along with foreign container liner services that call at the Port of Busan, there are over 160 local container liner operators in South Korea that are performing their global services routes on weekly schedules and link to over 500 ports in 100 countries across the world. Some of them have collaboration with international shipping groups such as COSCO of China, Yang Ming of Taiwan, K-Line of Japan and others. (Website of Mercator Media Ltd. 2016).

5.3.4 Conclusion

Since China became a member of the WTO in 2001, dramatically boosted containerized cargo traffic and transhipment volumes had induced demand of the adequate container-handling infrastructure that would be capable to deal with this growth. On one side, China has difficulties to provide a sufficient number of natural deep-water harbours to accommodate large container vessels. On the other hand, the South Korean's ports with their optimal geographical features are able to attract many shipping operators instead of Chinese ports. (Cullinane & Song 2007, 54-58).

In an effort to enhance in particular the Busan port's position, the Busan Port Authority decided to develop new container terminal areas involving the transformation the New Port into "a word-class port". By 2020, the port is planned to equip a total of 45 berths having 17 m of water depth. It will enable to handle an annual capacity of about 16 million TEU of cargo. Additionally to advance the efficiency of terminal operations, the port's government established the construction plan of a 9,44 million m^2Distripark with "high-tech cargo-handling facilities". (Website of Busan Port Authority 2016).

As a disadvantage of the current situation at the port, it should be mentioned the limited hinterland area that leads to the lack of handling capacity. Some analysts emphasize that "containers at Busan port are currently handled far beyond its planned capacity". So taking into account "the future growth of container traffic in Northeast

Asia", the port is extremely required to increase its territories. (Cullinane & Song 2007, 58-60).

To draw the summary of this part, one can say that, in spite the existence of certain negative points, the local government remains productively to develop a number of business strategies that focus on the maintenance the position of the Busan port as one of the top container ports in the world. (Cullinane & Song 2007, 58-60).

5.4 Singapore

The Port of Singapore is probably the most remarkable subject for a study examination. Being "the busiest container transhipment hub in the world", the port serves an essential position in the national economy of Republic of Singapore. The country limited with territory and natural resources has a highest rate of GDP in the region where the service sector is 70,4 per cent of nominal value (Figure 8). (Website of CIA 2016).

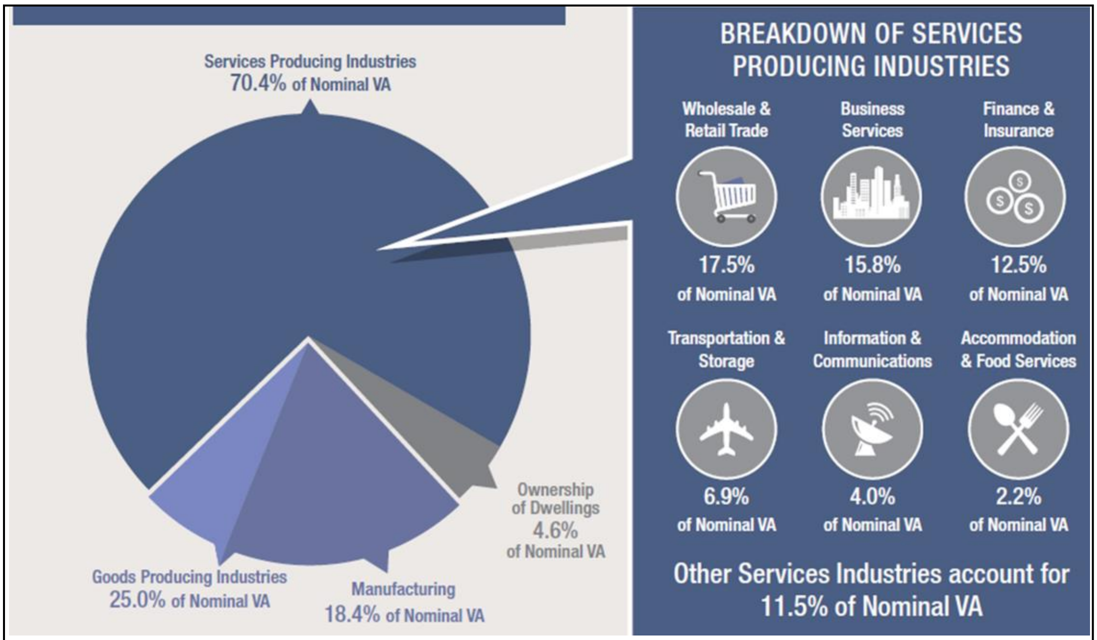


Figure 8. Structure of the Singapore's economy in 2014. (Economic Survey of Singapore 2014)

Supported by the government, the development of Singapore as "a global port city with an industrial backyard" with low taxes and few capital restrictions have transformed into “the premier international trading and logistics hub of Southeast Asia”. The Port of Singapore handled 33,869 million TEUs of cargo in 2014, is the second biggest port in the world. (Zarroli 2015; Vinnie 2014; Review of Maritime Transport 2015, 70).

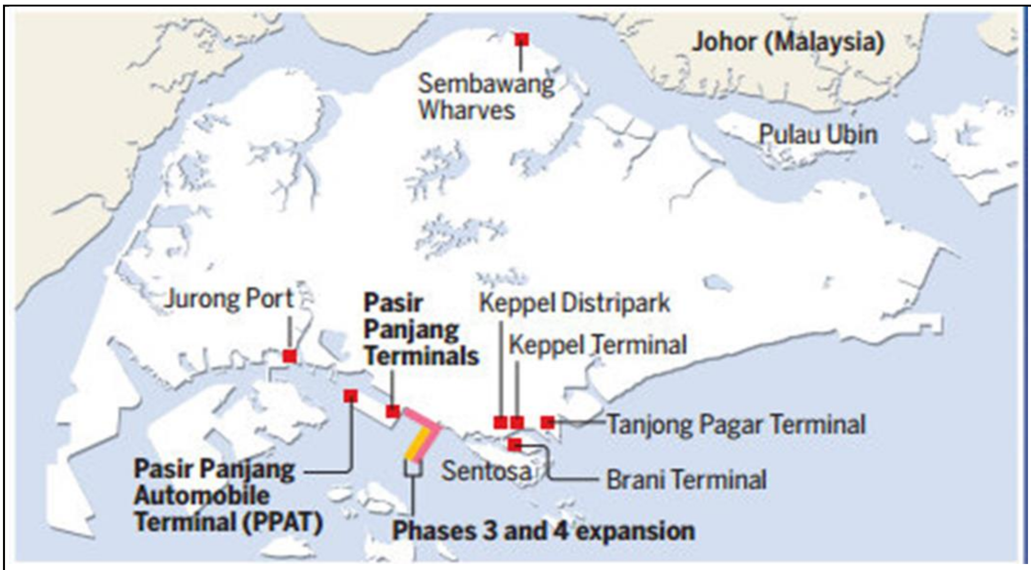
All operation and activities at the Port of Singapore are completely consolidated on the control of the Maritime and Port Authority of Singapore (MPA) established in 1996. This kind of management supports the direct regulation of the port’s performance and services, such as the control navigational safety and vessel movements, the designing and determination of the future port development. As a government representative, the MPA develops national sea transport policy and participates in regional and international forums. (Cullinane & Song 2007, 144-146; Website of Maritime and Port Authority of Singapore).

5.4.1 Geographical features

The Port of Singapore has an ideal geographical position at the crossroads of the main shipping routes between Europe and the Far East existing for more than a thousand years. In addition, situated close to most dynamic economies, such as China and Japan, the port became an important center of logistics and global trades. As a “flagship of the industry”, the Lloyd's List Asia rewarded Singapore Terminals of "Container Terminal Operator of the Year" for the tenth time. (Toh& Tan 1998, 100-102; Website of Ship-Technology (Projects) 2016; Website of PSA Singapore 2016).

5.4.2 Container terminal facilities and infrastructure

The Port of Singapore has three commercial terminal operators - PSA Corporation Limited, Jurong Port Pte Limited, and the Singapore Cruise Centre Pte Limited. However, the main container-handling areas are totally managed by PSA Corporation Ltd since 1964. At the territory of the 600 hectare are located four container terminals – Tanjong Pagar, Brani, Keppel, and Pasir Panjang (Picture 9) - with a total of 57 berths that enable to carry all vessel types including the mentioned biggest container vessel, the Emma Maersk. (Website of World Port Source 2016; Website of PSA Singapore 2016; Website of Ship-Technology (Projects) 2016).



Picture 9. The Port of Singapore (Lee 2015).

Singapore's main container terminals

In Table 13 are combined facilities of three primary container terminals at the Singapore port.

Pasir Panjang Terminal

Situated about 7 kilometers west of the container terminals in Keppel Harbor, the Pasir Panjang Terminal (Picture 8) is the newest innovative container area which started operating in 1998 and still remained in the development. The plan of enhancement of Pasir Panjang Terminal (PPT) concerns the aim to increase the capacity by 18 million 20-foot TEUs contains several phases. The Table 14 represents facilities of the completed Phases of the Pasir Panjang Terminal. (Website of PSA Singapore 2016).

Table 13. The primary container terminals facilities. (Cullinane & Song 2007, 135; Website of World Port Source 2016)

Terminal	Area (hectares)	Quay length (meters)	Berths	Cranes	Groundslots	Reefer (points)
Brani	79	2629	5 main 4 feeder	29 QC 105 RTG 5 RMG 2 BC	15,424	1,344
Keppel	96	3220	4 main 10 feeder	36 QC 106 RTG 13 RMG	20,230	936
Tajong Pagar	80	2320	6 main 2 feeder	29 QC 95 RTG	15,940	840
Additionally:						
Cosco-PSA Terminal	22.8	720	2 main	unknown	unknown	unknown

Table 14. The PasirPanjang Terminal facilities. (Website of PSA Singapore 2016)

Terminal	Area (hectares)	Quay length (meters)	Container berths	Cranes	Max depth (m)
Pasir Panjang Terminal 1	88	2 500	7	28 QC	15.0
Pasir Panjang Terminal 2	120	2 300	7	24 QC	16.0
Pasir Panjang Terminal 3	113	3 000	9	34 QC	16.0
Pasir Panjang Terminal 5	110	1 850	5	22 QC	18.0

By 2020, the Maritime and Port Authority of Singapore (MPA) intends to complete the development of Phases 3 and 4 at Pasir Panjang container area and expand 15 more berths with upgrading them up to 18 meters deep. In addition in terms of the growth of port productivity, it is planned to renovate the terminal facilities such as “a zero-emission and fully-automated electric yard crane system". (Website of Ship-Technology (Projects) 2016).

5.4.3 Container liner services

Container liner services that call at the Port of Singapore cover more than 700 ports in 130 countries around the world. There are 2-3 ships departing the Singapore port every minute. On average, the port is visited 140 000 vessels annually. (Rodrigue & Slack 2003; World's Top 5 Ports 2010).

5.4.4 Conclusion

All things considered, it should say that, undoubtedly, the Singapore port is a unique place. In the world, there are few places having alike advantageous location as the Singapore port - Suez, Panama, Cape Town, and Gibraltar. But the strategic position along the Straits of Malacca, through which are passing over 600 ships daily, was adopted only by Singapore to transform factually into the one big transhipment base. Having a territory at most 600 hectare, the port handles 30 million containers and 500 million tons of cargo annually. Herewith, some experts jokingly calculated that, in the Republic with a population at 5,54 million people (est. 2015) there are over five containers for each inhabitant of Singapore. (Cullinane & Song 2007, 135-140; Singapore Population 2015; Website of Maritime and Port Authority of Singapore 2016).

To handle this volume of cargo traffic, the MPA tends to develop the port infrastructure not only in the terms of the number of container berths, cranes or storage facilities, but also in terms of quality of all facilities, the port information systems, port-related and ship-related services. Moreover, there are a number of district parks covered over half a million square meters of warehousing with automated storage facilities at the terminal areas. (Cullinane & Song 2007, 220).

These actions are defined by an increasing competition of Chinese container ports, in particular Shanghai, due to China's rapid economic growth over the past 20 years.

Also some analytics assume that, with a continued growth of China, India and the Southeast Asian economies, the Port of Singapore “might lose some share in the overall maritime business market” and even be overtaken by other Chinese ports such as Ningbo, Guangzhou and Shenzhen. (Cullinane & Song 2007, 134-140).

However to meet these competitive confrontations, the MPA develops know-how plans and strategic approaches that help the Port of Singapore to stay the region’s premier port in the future. As a port operator of choice, PSA has been voted the "Best Sea Port in Asia" for the 27th time at “2015 Asian Freight, Logistics & Supply Chain Awards” that also could be the best estimation of the professional performances of the port. (Cullinane & Song 2007,134-140; Website of PSA Singapore).

6 CONCLUSION

The purpose of this thesis was to provide a comprehensive study of container shipping within the maritime transport system from the point of the transportation by ocean on the liner route between Europe and East Asia. The validity and reliability of the research results are justified with appropriate selection of research methodology and the adequate methods of the work’s organization consisting of the four parts which successively outline the progress of study from general to the primary subject. For achieving the principal objectives of the project were implemented the extensive theoretical analysis of academic literatures and contemporary open sources. Therefore, the final results presented in the work were supported with the chosen methods and have fully reflected in the content of the thesis.

The results of this thesis could be useful for multifarious audience for studying global shipping services, containerization, the type of container ships, and the features of the largest container terminals located in the ports of East Asia. In the case of the application this work, the attention of further researchers should be paid to the statistics information which will be updated every year on the relevant resources.

The study topic has the extensive scope, so this thesis could generate new researches that examines deeper the areas covered on this work such as macroeconomic structure of the shipping market, liner shipping services and organizations, evolution of the container fleet, and the repositioning of empty containers making big challenge for international companies and required productive solutions.

7 SUMMARY

All things considered, it should be summarized briefly the key points of the completed research work.

In the first part are described the general aspects of the thesis concerning research problems and methodology.

The second part reviews the geographical framework within the global maritime industry. The overview mainly focuses on the two most significant trade markets – Europe and East Asia – covering main shipping areas and ports in these regions. Also this part outlines the key segments of the global maritime transport system and cargo types which these shipping services carry. In maritime economics, the shipping industry is adopted to divide into three sectors concerning relevant cargoes: bulk shipping service transporting liquid, homogeneous and minor bulk cargoes; liner shipping service carrying manly containerized cargo; and specialized shipping services used for the mix of bulk and general cargo transportation.

The third chapter devotes an attention of container types and main features of containerization. In recent time, for the transportation of different categories of goods that can be packed are used the five common types of containers depending on their purposes. The containers are specified by International Standards Organization (ISO) in their dimensions (20 or 40 ft length by 8 width and height) and have an accepted measurement for volume of storage capacity – TEU, twenty-feet-equivalent unit.

The fourth chapter considers more detailed how containers are transported and what kinds of vessels provide this operation. Thus, the development of containerization as a method of cargo transportation have changed liner shipping industry and made this service cost-effective and faster.

According to the Review of Maritime Transport 2015 posted by UNCTAD that was mentioned within the thesis, about 35 per cent of the world's liner shipping market belong to the three liner companies – Maersk line, MSC and CMA CGM, which vessels capacity together equals above 6 500 million TEU by 1 May 2015. (Review of Maritime Transport 2015, 37).

The final chapter actually examines container-handling terminals in the major ports in the region of East Asia – Shanghai, Busan and Singapore. In the top 20 container terminals ranked by UNCTAD in 2015, Shanghai stands on the first place with a total 35 290 million TEU of container throughput. Singapore follows after Shanghai and places the second position with 33 869 million TEU. Busan which represented in the examination and handled 18 678 million TEU of word container throughput is only on the sixth place in the list. However, this port is located in the region that had competitive position as one of the noticeable trade market along with the EU. (Review of Maritime Transport 2015, 69).

This chapter also includes in detail the description of principal characteristics of terminals which are important for shipping companies' port choice concerning appropriate cargo-carrying facilities, the suitable location for container storages and relevant logistics service centers. For the comparing of this point, the Port of Rotterdam was chosen as "super-terminal" called in this manner by Martin Stopford, the author of Maritime economics. (Stopford 2009, 562).

To conclude, one should say that, in the face of impacts of the world financial crisis, the ongoing slowdown of globalization leads to the decline of the demand in the container shipping industry. In the opinion of the global shipping consultancy 'Drewry', the liner shipping services that were intensively developing before the crisis and were the one of the perspective sector in cargo shipment "have fallen to historical lows". Thus, the container liners are seeking the more radical decisions to cope with appearing circumstances. However, Drewry's forecasting is pessimistic: "Container shipping is set for another three years of overcapacity and financial pain", commented in the Drewry Maritime Equity Research.(Website of Drewry Shipping Consultants Ltd. 2016).

8 FINAL WORDS

I started to explore a topic for my final thesis during last two study years. It was problematically as well as Finnish companies operating in my study area have a hidden access for outsiders. For this reason, I decided to choose the topic which was covered not fairly wide in the course of the education at the Satakunta University of Applied Sciences.

I am sufficiently content of the gained result. It was difficult process but, finally, I have reached all my objectives. Unfortunately, I was not able to include all information that was gathered within this work due to prescribed limitations. The mentioned theme has extensive scope, so definitely other students seeking a topic for their own researches could find here new ideas.

In the process of writing my thesis, I surely faced problems concerning especially port's facts. I have detected that there is the meager information even about the word's megaports in open sources. However, although the exploring has taken more time than it was scheduled, I was able to obtain required data for my research.

One should also notice that the thesis topic was selected reasonably. I gained significant knowledge that can apply for my current job position. It is an international company which is manufacturing its production in China and transporting then in containers by ocean. Due to examined appropriate academic literatures, I am more competent to face new issues that emerge in my work.

Finally, I would like to say that it was a very interesting work, so I am thankful my supervisor for the opportunity to choose exactly this theme for my thesis and also for his guidance during all thesis writing process.

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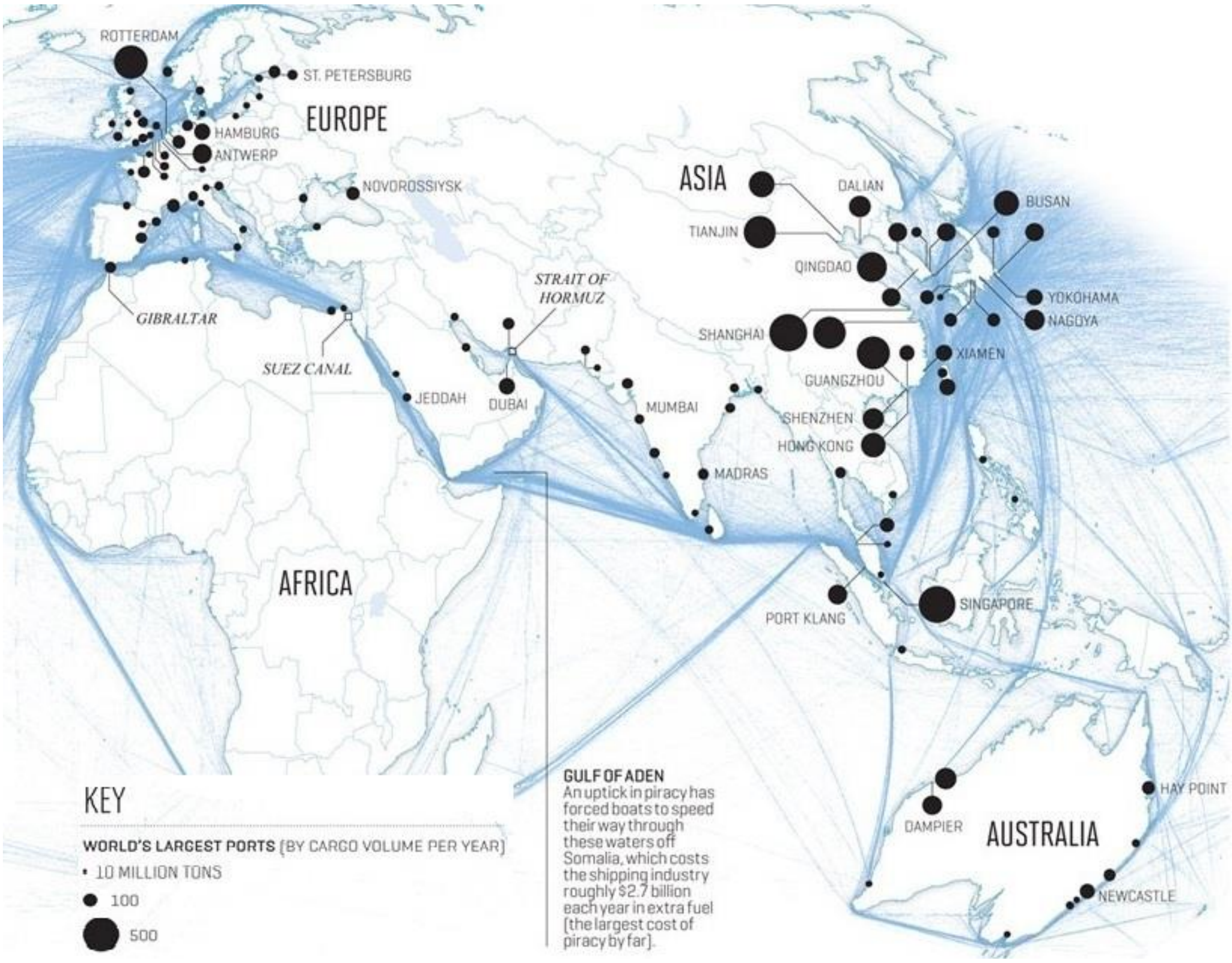
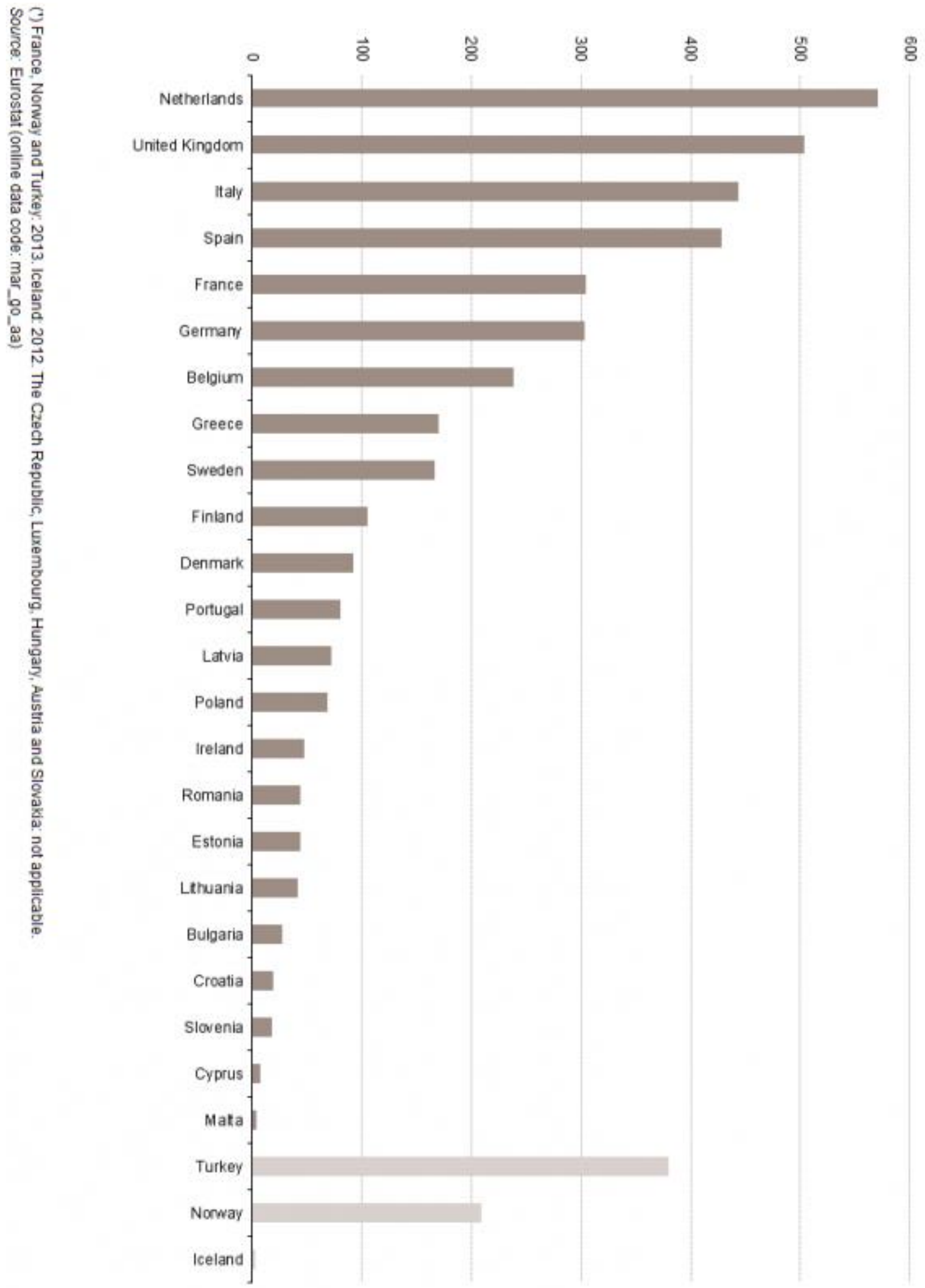
APPENDIX 1

Map 1. Major shipping routes between Europe and Asia (Website of Vox Media 2016).



APPENDIX 2

Figure 3. Gross weight of seaborne goods handled in ports, 2014 ([1]) (million tons) (Website of European statistics. Statistics Explained 2016)



APPENDIX 3

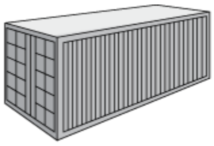
Table 1. Top 20 cargo ports in 2013 - on the basis of gross weight of goods handled (in million tonnes) (European statistics. Statistics Explained 2016)

Rank 2013	Port	*	1997	2007	2008	2009	2010	2011	2012	2013									Growth rate 2012-2013 (%)	Average annual growth rate 1997-2013 (%)
										By direction			By type of cargo handled (%)							
			Total	Total	Total	Total	Total	Total	Total	Inwards	Outwards	Total	Liquid bulk goods	Dry bulk goods	Large con-tainers	Ro-Ro Mobile units	Other cargo, nes	Unkown		
1	Rotterdam (NL)	=	303.4	374.2	384.2	353.9	395.8	396.5	405.3	291.0	115.5	**406.5**	49	21	23	3	4	0	**+0.3**	**+1.8**
2	Antwerpen (BE)	=	104.6	165.5	171.2	142.1	160.0	168.5	164.5	89.0	83.0	**172.0**	34	8	49	3	6	0	**+4.5**	**+3.2**
3	Hamburg (DE)	=	69.6	118.2	118.9	94.8	104.5	114.4	113.5	68.5	52.1	**120.6**	12	23	63	1	1	0	**+6.2**	**+3.5**
4	Amsterdam (NL)	+2	36.9	62.5	74.4	72.7	72.7	67.2	69.6	63.0	30.2	**93.2**	47	43	0	1	9	0	**+33.9**	**+6.0**
5	Marseille (FR) [1]	-1	92.9	92.6	92.5	79.8	82.4	84.5	81.8	57.3	19.0	**76.2**	65	16	11	6	0	2	**-6.8**	**-1.2**
6	Algeciras (ES)	-1	34.2	62.1	61.9	55.8	58.6	68.8	74.6	41.2	33.5	**74.7**	33	2	59	2	4	0	**+0.1**	**+5.0**
7	Le Havre (FR) [1]	+3	58.2	73.9	75.6	69.2	65.8	63.4	59.2	46.6	17.8	**64.4**	61	2	29	1	1	6	**+8.7**	**+0.6**
8	Immingham (UK)	-1	48.0	66.3	65.3	54.7	54.0	57.2	60.1	46.4	16.2	**62.6**	36	38	2	23	1	0	**+4.2**	**+1.7**
9	Izmit (TR)	-1	:	:	52.8	46.9	53.8	55.0	60.6	44.0	16.7	**60.7**	36	38	14	0	12	0	**+0.2**	:
10	Botas (TR)	-3	:	:	60.0	72.0	68.3	65.5	61.2	10.4	45.7	**56.1**	85	14	0	0	1	0	**-8.4**	:
11	Bremerhaven (DE)	=	16.6	43.6	49.0	42.7	45.9	55.9	58.2	24.0	30.5	**54.5**	0	0	90	7	2	0	**-6.4**	**+7.7**
12	Valencia (ES)	+1	16.3	45.9	50.2	48.3	53.1	54.2	54.2	24.8	28.9	**53.7**	8	5	77	2	10	0	**-0.9**	**+7.7**
13	Bergen (NO)	-1	:	61.2	52.4	56.0	49.8	52.3	54.6	12.9	38.9	**51.8**	91	6	0	0	2	0	**-5.1**	:
14	Trieste (IT)	+3	42.1	39.8	37.2	41.0	40.6	41.8	42.1	39.8	6.1	**46.0**	73	3	8	13	3	0	**+9.1**	**+0.6**
15	London (UK)	-1	55.7	52.7	53.0	45.4	48.1	48.8	43.7	36.4	6.8	**43.2**	29	27	19	18	8	0	**-1.2**	**-1.6**
16	Milford Haven (UK)	+4	34.5	35.5	35.9	39.3	42.8	48.7	39.8	25.6	15.5	**41.1**	98	0	0	2	0	0	**+3.2**	**+1.1**
17	Genova (IT)	-1	42.2	48.4	46.5	42.7	41.4	42.4	42.5	27.5	13.3	**40.8**	43	3	33	19	1	0	**-3.8**	**-0.2**
18	Piraeus (EL)	+6	8.9	18.9	8.8	10.1	13.1	23.5	35.2	20.9	19.3	**40.2**	1	1	87	10	0	0	**+14.2**	**+9.9**
19	Aliaga (TR)	-4	:	:	37.6	31.4	37.4	37.6	42.6	25.6	13.9	**39.5**	48	35	11	0	6	0	**-7.2**	:
20	Ambarli (TR)	+2	:	:	26.7	19.7	28.8	33.7	35.6	23.5	15.7	**39.2**	7	9	83	1	0	0	**+9.9**	:
Total top 20 ports [2]		-	:	**1 588.8**	**1 641.3**	**1 473.6**	**1 563.4**	**1 608.4**	**1 609.9**	**1 018.4**	**618.6**	**1 637.0**	43	17	32	4	4	0	**+1.7**	:
EEA-IS+TR (all ports)		-	:	:	**4 446.5**	**3 945.5**	**4 205.7**	**4 328.2**	**4 320.1**	**2 533.3**	**1 773.4**	**4 306.6**							**-0.3**	:

** This column indicates the number of positions lost or gained compared to 2012.*
(1) Data by type of cargo have been estimated by Eurostat based on partial data.
(2) Total figure for the ports being part of the top 20 ports during the reference year concerned.

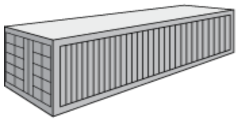
APPENDIX 4

Table 3. Ocean container dimensions. (Website if SCM-Daleel 2016; Hapag-lloyd's brochure container specification, 2010)



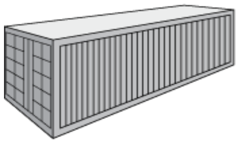
STANDARD 20'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
19'4"	7'8"	7'10"	7'8"	7'6"	1,172 ft³	4,916 lb	47,999 lb
5.89 m	2.33 m	2.38 m	2.33 m	2.28 m	33.18 m³	2,229 kg	21,727 kg



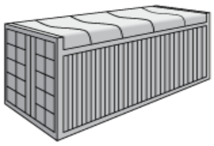
STANDARD 40'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
39'5"	7'8"	7'10"	7'8"	7'6"	2,390 ft³	8,160 lb	59,040 lb
12.01 m	2.33 m	2.38 m	2.33 m	2.28 m	67.67 m³	3,701 kg	26,780 kg



HIGH CUBE 40'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
39'5"	7'8"	8'10'	7'8"	8'5"	2,694 ft³	8,750 lb	58,450 lb
12.01 m	2.33 m	2.69 m	2.33 m	2.56 m	76.28 m³	3,968 kg	26,512 kg

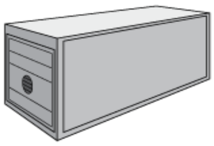


OPEN TOP 20' (UPGRADED ALSO AVAILABLE)

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
19'4"	7'7"	7'8"	7'6"	7'2"	1,136 ft³	5,280 lb	47,620 lb
5.89 m	2.31 m	2.33 m	2.28 m	2.18 m	32.16 m³	2,394 kg	21,600 kg

OPEN TOP 40'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
39'5"	7'8"	7'8"	7'8"	7'5"	2,350 ft³	8,490 lb	58,710 lb
12.01 m	2.33 m	2.33 m	2.33 m	2.26 m	66.54 m³	3,850 kg	26,630 kg

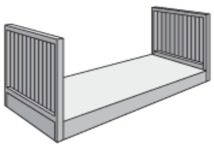


REEFER 20'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
19'4"	7'7"	7'8"	7'6"	7'2"	1,136 ft³	5,280 lb	47,620 lb
5.89 m	2.31 m	2.33 m	2.28 m	2.18 m	32.16 m³	2,394 kg	21,600 kg

REEFER 40'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	DOOR WIDTH	DOOR HEIGHT	CAPACITY	TARE WEIGHT	MAX. CARGO
39'5"	7'8"	7'8"	7'8"	7'5"	2,350 ft³	8,490 lb	58,710 lb
12.01 m	2.33 m	2.33 m	2.33 m	2.26 m	66.54 m³	3,850 kg	26,630 kg



FLAT RACK 20'

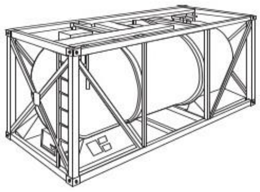
INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	TARE WEIGHT	MAX. CARGO
18'5"	7'3"	7'4"	5,578 lb	47,333 lb
5.61 m	2.20 m	2.23 m	2,530 kg	21,469 kg

FLAT RACK 40'

INSIDE LENGTH	INSIDE WIDTH	INSIDE HEIGHT	TARE WEIGHT	MAX. CARGO
39'7"	6'10"	6'5"	12,081 lb	85,800 lb
12.06 m	2.08 m	1.95 m	5,479 kg	38,918 kg

Tank Container 20'

ISO Size Type Codes: 20T5 = 8' high, 22T0 = 8'6" high, 22T5, 22 T6



APPENDIX5

Table 4. The principle of pallet unit loads. (Military Pallets, Boxes and Containers 2014).

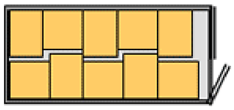
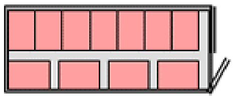
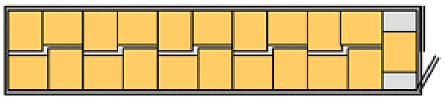
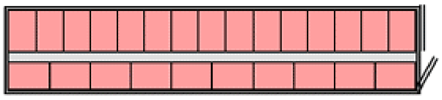
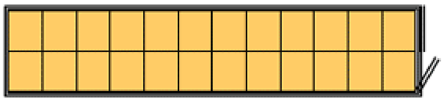
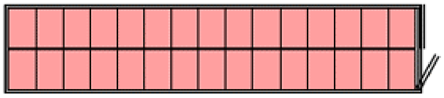
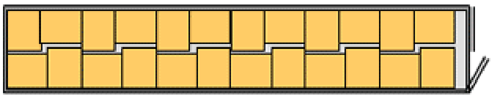
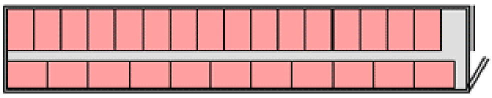
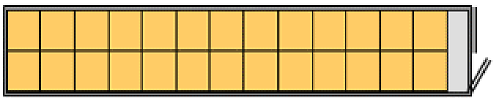
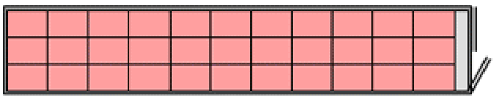
20' STANDARD	10 standard pallets 1,2 x 1,0m	
	11 europallets 1,2 x 0,8m	
40' STANDARD	21 standard pallets 1,2 x 1,0m	
	25 europallets 1,2 x 0,8m	
40' PALLETWIDE	24 standard pallets 1,2 x 1,0m	
	30 europallets 1,2 x 0,8m	
45' STANDARD	24 standard pallets 1,2 x 1,0m	
	27 europallets 1,2 x 0,8m	
45' PALLETWIDE	26 standard pallets 1,2 x 1,0m	
	33 europallets 1,2 x 0,8m	

Table 7. Ownership of the world fleet, as of 1 January 2015 (dwt) (Review of Maritime Transport 2015, 36).

Rank (dwt)	Country/territory of ownership	Number of vessels			Dead-weight tonnage				
		National flag	Foreign flag	Total	National flag	Foreign flag	Total	Foreign flag as a % of total	Total as a % of world
1	Greece	796	3 221	4 017	70 425 265	209 004 526	279 429 790	74.80%	16.11%
2	Japan	769	3 217	3 986	19 497 605	211 177 574	230 675 179	91.55%	13.30%
3	China	2 970	1 996	4 966	73 810 769	83 746 441	157 557 210	53.15%	9.08%
4	Germany	283	3 249	3 532	12 543 258	109 492 374	122 035 632	89.72%	7.04%
5	Singapore	1 336	1 020	2 356	48 983 688	35 038 564	84 022 252	41.70%	4.84%
6	Republic of Korea	775	843	1 618	16 032 807	64 148 678	80 181 485	80.00%	4.62%
7	Hong Kong, China	727	531	1 258	56 122 972	19 198 299	75 321 271	25.49%	4.34%
8	United States	789	1 183	1 972	8 731 781	51 531 743	60 263 524	85.51%	3.47%
9	United Kingdom	477	750	1 227	12 477 513	35 904 386	48 381 899	74.21%	2.79%
10	Norway	848	1 009	1 857	17 066 669	29 303 873	46 370 542	63.20%	2.67%
11	Taiwan Province of China	117	752	869	4 681 240	40 833 077	45 514 317	89.71%	2.62%
12	Bermuda	5	317	322	289 818	41 932 611	42 222 429	99.31%	2.43%
13	Denmark	392	538	930	15 286 153	20 893 511	36 179 664	57.75%	2.09%
14	Turkey	576	954	1 530	8 321 506	19 366 264	27 687 770	69.95%	1.60%
15	Monaco		260	260		23 929 323	23 929 323	100.00%	1.38%
16	Italy	596	207	803	15 961 983	6 040 199	22 002 182	27.45%	1.27%
17	India	697	147	844	14 546 706	7 268 449	21 815 155	33.32%	1.26%
18	Brazil	228	163	391	3 150 493	17 308 798	20 459 291	84.60%	1.18%
19	Belgium	87	156	243	7 302 545	12 787 196	20 089 741	63.65%	1.16%
20	Russian Federation	1 291	448	1 739	5 920 435	12 403 644	18 324 079	67.69%	1.06%
21	Islamic Republic of Iran	157	70	227	3 986 804	14 093 340	18 080 144	77.95%	1.04%
22	Switzerland	47	291	338	1 403 668	16 492 768	17 896 436	92.16%	1.03%
23	Indonesia	1 504	153	1 657	12 908 577	4 120 935	17 029 512	24.20%	0.98%
24	Netherlands	775	445	1 220	6 589 901	10 415 708	17 005 609	61.25%	0.98%
25	Malaysia	466	142	608	8 430 359	7 707 526	16 137 885	47.76%	0.93%

APPENDIX 7

Table 8. The world's biggest container ships of the last generation. (Website of Ship-spotting 2016, Website of Ship-Technology (Features) 2013, Website of Marine Traffic 2016).

Maersk Triple E Class MV Maersk Mc-Kinney Møller - carrying capacity : 18 270 TEU - deadweight : 165 000 t, - length : 400 m, - width : 59 m, - 14.5m in draught	
Explorer Class CMA CGM Marco Polo - carrying capacity : 16 020 TEU - deadweight : about 188 000 t, - length : 396 m, - width : 54 m, - draught: 16 m	
Maersk E Class Emma Maersk - carrying capacity : 14 770 TEU - deadweight : 170 974 t, - length : 397,71 m, - width : 56,4 m, - draught: 15 m	
"Neo-overpanamax" CSCL Star - carrying capacity : 14 100 TEU - deadweight : 155 470 t, - length : 366,07 m, - width : 52 m, - draught: 13,2 m