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Piraeus Container Terminal Competitiveness in the Eastern and Central Mediterranean

by

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ii. Abstract

Our thesis focuses on the competitiveness of the Piraeus container terminal in the eastern and central Mediterranean region. More specifically, our analysis consists of the nine biggest container ports (in terms of cargo volume) in an inter-port level. Unfortunately, due to severe lack of available statistical data we could not include in our core analysis, if the selected ports operate in the transshipment or the getaway market. In order to reach the desired conclusions, the thesis has the following structure. At the beginning, we present the necessary literature in order to identify which are the crucial factors, which influence the competitiveness of a container port. Later on, we define which are the available methodologies for the identification and measurement of inter-port competition. Before proceeding with the core of our analysis we defined our market and selected the ports that we will study. Later, we take under consideration elements which influence the demand (in terms of TEU's) and the supply side of the E. & C. Mediterranean port industry (e.g. cargo handling equipment). We analyzed those elements in an attempt to pave the way for our core study. In the beginning of our main analysis we identified the port competition in the East and Central Mediterranean Sea by classifying nine ports into four homogeneous subsets. The first subset represents the lowest (average) cargo volumes and the fourth one the highest. With the help of the one-way ANOVA analysis and a post-hoc test (Tukey's honesty significant difference) we concluded that the port of Gioia Tauro ranked first (subset 4), Port Said and Marsaxlokk ranked second (subset 3) with the rest of the ports following. These conclusions are based on the cargo volume data for the years 2003 to 2009. In a second, more analytical effort, we used a model that has been proposed by Dr. Michalopoulos in 2006. This model measures port competition and determines the market position of ports by using a remarkable number of variables. It is based on the benchmarking technique and we came to the conclusion that the port of Gioia Tauro is the leader port, while the port of Piraeus is clearly below the average in the eastern and central Mediterranean Sea. Finally, we came to the conclusion, that through the investment plans and strategies of both terminal operators, the container terminals of Piraeus will create the appropriate conditions for a positive shift in competitiveness.

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AGV	Automated Guided Vehicles
ALV	Automated Lifting Vehicles
COSCO	China Ocean Shipping Company
DCCHC	Damietta Container & Cargo Handling Co.
EDI	Electronic Data Interchange
E. & C.	Eastern and central (Mediterranean)
HPH	Hutchison Port Holdings
ISPS	International Ship & Port facility Security
MSC	Mediterranean Shipping Company
PCT	Piraeus Container Terminal
PPA	Piraeus Port Authority
PSCCHC	Port Said Container & Cargo Handling Co.
RMG	Rail-Mounted Gantry crane
RTG	Rubber-Tired Gantry crane
SCCT	Suez Canal Container terminal
TCT	Taranto Container Terminal
TEU	Twenty-foot Equivalent Unit

Chapter 1: Introduction

1.1 Introduction

Container terminals and ports in general represent a crucial factor in the modern economy. Especially during the last decades, ports have changed rapidly compared with other industries. This was an outcome of the trade globalization, IT systems, logistics integration, deregulation and containerization. Furthermore, important developments that took place in the container vessels influence directly the port industry. The most characteristic example is the introduction of the economies of scale, which lead to the gigantism of the ships. This gigantism changed the environment of the total transportation industry and (among others) influenced deeply the container port sector.

During the last decades the most competitive container ports started to suffer from remarkable pitfalls in the provision of in-time quality services. In order to reverse the aforementioned problem and to increase their attractiveness many ports started investing in their infrastructure, superstructure, cargo handling equipment, information systems and in strategies (e.g. alliances). Those investments was a necessarily step not only for the satisfaction of the customer needs, but also for the improvement of the port competitiveness. In that way, plenty port authorities and terminal operators invested in the features of ports (e.g. depth, storage area, cranes) trying to attract bigger vessels and positively shift their demand.

Nevertheless, not all the regions developed during the same period and at the same rate. For example, the Hamburg - Le Havre range and the Asian region have been rapidly developing during the previous years. In what concerns the Mediterranean region, we can indentify that in the container sector the region did not present such a high development, compared with the aforementioned regions (Notteboom, 2010). This comparison can take place not only in terms of size, service level or technology but also in terms of cargo volume that each region handles. However, even in this region we notice some importance ports in terms of cargo volume (e.g. Gioia Tauro, Port Said, Marslaxlokk) which operate in the eastern and central Mediterranean Sea.

Nevertheless, if we take under consideration other parameters (that is, except cargo volume), then we cannot draw any conclusions (in terms of port competitiveness) that easily. A significant number of variables influence the competitiveness of a container port. Song and Yeo (2004), support that the four most critical factors (apart from cargo volume) are: port location, port service level, port facility and port cost. Also Itoh and Doi (2002), determined three variables which influence the competitiveness of a port. Those are the geographical location, the number of calls and the number of the routs offered at the port.

In many cases (e.g. port cost) however, it is not possible (due to limited accessibility of data) to take under consideration crucial variables when we want to measure the competitive position of a container port in a defined market. However, as we will see later on, we can use many characteristics of a port in order to obtain to the desired results. We have to make clear that except from the aforementioned variables a

remarkable number of elements influence the port competitiveness. For instance, dedicated terminals from global carriers influence dramatically the competitiveness of a container terminal due to the vertical integration that is being developing (Pallis and Vitsounis, 2009).

Nowadays, because of the economic crises, most of the containers ports are finding difficulties in the realization of their investment plans due to the lack of liquidity. Even in cases when projects have started before the crisis, (e.g. Maasvlakte 2) they might continue but even then they continue with in a more sluggish way and subsequently, with more slow delivery time. However, in some cases (e.g. Piraeus Port), new opportunities can derive from the establishment of a global container terminal operator with plenty of cash and know-how.

The scope of this thesis is to identify the position of the Piraeus container port in 2009. The comparison will take place in the E. & C. Mediterranean Sea. The variables that we will take under consideration are selected after an extensive literature review and with the idea that the data can be collected from reviews and other sources. It would be very desirable to include more variables such as the number of calls, but those data are not published from the port authorities and the terminal operators.

After the identification of the position of Piraeus port, another important aim is the examination of the new opportunities that the aforementioned port has with the establishment of COCSO company in the Piraeus Container Terminal (PCT). Finally, we will examine the investment plans and some other strategies of the Piraeus container terminal operators. The aim of these investments and strategies is to increase the competitiveness of the Piraeus port.

1.2 Research questions

The aim of this study is to recognize and measure the competitive position of the Piraeus container port in the eastern and central Mediterranean region. The region was selected based in the geographical position of the Piraeus port. In this regard, the western Mediterranean ports are out of our examination, because they are not, in reality, direct competitors to the Piraeus container terminal. Additionally, the ports of Marama and the Black Sea were not selected due to the fact that these harbors are not included in the specific geographical area of our study.

Considering the studies in the field of port competition, we can find various researches in other regions and very few in the Mediterranean Sea. For example, the Hamburg – Le Havre region was extensively analyzed during the previous years and the Asian range has also a big variety of researches in this portfolio. The Mediterranean region, however and especially the examination of the inter-port competition in the eastern and central Mediterranean Sea is a unique and very interesting approach.

In our point of view, it is scientifically incorrect to analyze the entire port sector, so we will focus only on the container terminals of the selected ports. In that way, it will be possible to make a comparison between similar organizations in the chosen area. The selection of this industry was inspired mainly due to the rapid

development of this market during the last decades. This development pressured the container terminals to increase their level of investments and services, in an effort to meet the growing demand of the container transportation.

The identification and measurement of the inter-port competition between the eastern and central Mediterranean container ports will be based on several elements. More precisely, for the recognition of the port competition we will use the cargo volume (in TEU's) of the ports for a period of seven years. However, for the measurement of the inter-port competition of the year 2009, we will use 18 elements. In order to be able to support that each selected element influences the competitiveness of a port, we will provide in chapter two an extensive literature review on this matter.

The main research question of this study is the following:

1. *Is the Piraeus container port in a high competitive position in the eastern and central Mediterranean region?*

The study will try to estimate the competitive position of each port taking under consideration some competitive parameters which the port has. In other words, it will focus in the inter-port competition (between different ports) without taking under consideration the intra-port competition (between the same port). The reason for this decision is that some of the selected ports are having only one, major or smaller, terminal, while at the same moment, others have more than one container terminals. So, if we wanted to present separate analyses in each case, then the results would be extremely complicated and not easily comparable.

Questions arising directly or indirectly from the main research question:

2. *Which is the leader port in the eastern and central Mediterranean container market?*

Without the answer to aforementioned question, no serious analysis can be made later on. At this point, we have to mention that a necessarily step for the core of our analysis is to define which is the average port in the selected market.

3. *Are the rest of the chosen ports more competitive than the Piraeus container port?*

If the answer is yes, then we will try to identify which of the selected container ports (terminals) are higher and which lower in the classification (always according to the elements that we have chosen).

4. *Based on the examined variables, does the Piraeus port fall behind in some areas when compared with the leader port?*

The scope of this question is not just to answer "yes" or "no", but to understand which of the selected variables "are missing" from the Piraeus port when compared to the leader port in the specific area.

5. *Could the investment plans and strategies of Piraeus container terminal operators improve the competitiveness of the aforementioned port?*

The previous research questions will be investigated during the next chapters with our main pursuit to develop a better understanding of the competitiveness of the container ports in the eastern and central Mediterranean region.

1.3 Data collection

The collection of information for the eastern and central Mediterranean container ports was a relatively difficult process. The reason is that comparatively with other regions, only a few studies have been implemented on the eastern and central Mediterranean sea. In order to gather the necessarily data, one of the most important source was the Containerization International Yearbooks of the years 2009 and 2010. However, in many cases the information from this source was outdated and for that reason, we had to collect the necessary data from other sources, which were:

- Web sites of all port authorities and terminal operations.
- Statistical and annual reports of the terminal operations and port authorities.
- Emails and telephone communication with some port authorities and terminals operations.
- Interviews (e.g. Piraeus port authority).
- Reviews and news from global and Greek magazines-newspapers (e.g. Containerization International monthly review, Naftemporiki, Efoplistis).
- Web sites of various organizations (e.g. Bloomberg).

All these sources enabled the collection of the necessary data for the completion of the thesis.

1.4 Overview of thesis

Our thesis is divided into seven chapters. At the first chapter, we introduce the topic, informing the reader about the research questions and the sources from which we collected our data. In the second chapter, we provide an extensive literature review on port and container terminal competitiveness. During this part of our analysis, the reader will understand the basic elements, which influence the competitiveness of a

container port. In chapter three, we present two methodologies that have been used for the recognition of the port competition and three methodologies for the measurement of the port competition. The scope of this chapter is for the reader to get a general understanding about the aforementioned topic. In chapter four, we determine some crucial elements that influence the demand and supply of the E. & C. Mediterranean port industry. This chapter facilitates the path for the upcoming analysis and is divided into three parts: in the first part of the chapter we define the market (E. & C. Med. region) and we chose the ports that we will examine. In the second part of the same chapter, we study the growth rates of those ports in a period of seven years (2003-2007). Also, we study the nature of the demand (transhipment / getaway) based on literature review (without statistical data). In the third and last part of chapter four, we focus on some elements that influence the supply side of the container port industry. More specifically, we study the correlation of the container terminals with the global operators, as well as the cargo handling equipment used in each container terminal. In chapter five, we continue with the identification and measurement of the E. & C. Mediterranean inter-port competition, based on the theoretical background of chapter 3 and 4. The aim of chapter 5 is the reader to understand through our analysis, which is the average E. & C. Mediterranean port, which is the leader port and mainly, what position the Piraeus port holds. In chapter 6, we focus only on the case of Piraeus. We investigate the market of this harbour, the investment plans of the two existing container terminal operators and some other crucial strategies, which could influence the competitiveness of the aforementioned port. Finally in chapter 7, we present our conclusions considering this topic, our research limitations and finally the recommendations for further research.

Chapter 2: Literature review on port and container terminal competitiveness

2.1 Introduction

In this chapter we will present an overview of the main factors affecting the competitiveness of the container ports. The core of our literature review will focus on the container ports and not on the port sector in general. Moreover, our analysis will take under consideration the competition in inter-port level and not in intra-port level. However, because we have to clearly understand the different levels of competition; we will start our analysis with an explanation about the different types of port competition. Later, we will present an overview of the studies published concerning the elements, which influence the competitiveness of a container port. In the last part of this chapter we will provide some concluding thoughts and we will make some significant observations which we will use later in chapter five.

2.2 Different types of port competition

According to the World Bank (2007), we can identify the following types of port competition.

Intra-Port competition at operator level exists when within a port different companies operate different terminals. In most of the cases, this type of competition doesn't exist, but in the top container ports, this is a common phenomenon. An example of intra-port competition can be easily indentified in the case of the Hong Kong port in which nine different terminals are operated by five different operations (Hong Kong International Terminals Ltd (HIT), Modern Terminals Ltd (MTL), DP World, Asia Container Terminals Ltd (ACT) and COSCO-HIT).[1] One very important characteristic of the intra-port competition is the fact that is preventing the monopolistic pricing. Furthermore, these operators are fiercely competing among themselves on the level of services they provide, each one trying to increase its market share in terms of cargo volumes as much as possible. In such a way, the local and national economy are affected positively.

Intra-Terminal competition exists when two (or more) providers operate within the same terminal. In other words, *"Intra-terminal competition refers to companies competing to provide the same services within the same terminal"* (De Langen & Pallis, 2005, p. 3). For instance, two or more stevedores can operate within a terminal. However this type of competition is questionable because many times these different providers are likely to merge.

Inter-Port competition is the classic type of port-to-port competition. Considering this type of competition, a clear example can be indentified in the Hamburg-Le Havre region. Within this territory most of the ports are competing in the container

[1] This information has been collected from the web site of Hong Kong.

sector trying to increase as much as possible their container throughput. Our thesis will focus on this level of competition.

Competition of ports between different regions. In this case, we have a competition between different territories such as the Mediterranean region and the Hamburg - Le Havre region. Most of the times, these different zones do not share the same hinterland, however in some special cases, they could serve the same market. The most characteristic example is taking place in Europe in which the Mediterranean and the Northern European ports can serve the eastern and the central part of the Europe. Nevertheless, in this case, the northern European ports (Hamburg - Le Havre region) have higher level of specialization, investments and cargo flow while, on the other hand, the Mediterranean container ports have only started to developed, but speedily, mainly during the last years (Notteboom 2010).

2.3 Literature review on container port competitiveness

If we take under consideration that sea carriers have acquired a big proportion of the global trade, we can easily understand how ports have become a key element for the economic development of countries, providing facilities and services. In other words, the competiveness of ports plays critical role to the growth of the countries and depends on many factors such as, political, technological, geographical, social and ecological perspectives. The aim of this chapter is to present an overview of the major factors that influence the competition between the ports, based on bibliographical data. Van de Voorde & Winkelmans (2002) suggested that shipping lines are the most important players in the determination of the port of choice while at the same time, Robinson (2002) pointed that the shippers play the most critical role for the determination of the port of choice. Regardless those different points of view, the cargo flow seek for routs that offer the lowest possible costs for a given level of services. If we take under consideration that container ports are a node in the logistic chain, then we can easily reach the conclusion that the ports that can actually achieve this (lowest possible costs for a given level of services) will be most probably chosen as the port of call. Many times, the necessary step for the improvement of competitiveness is the development of horizontal and vertical integrations in the transport industry with an eye to achieve economies of scale and economies of scope. An example of this development is the dedicated terminals, which is a form of vertical integration. This development was the result of the shipper's requirements for better supply chain management and higher geographic coverage (Haralambides, 2002). Also, this development was influenced dramatically by the concentration of power by the liner companies, which developed joint ventures, mergers and alliances with the respective terminals. A very characteristic example of the importance of the vertical integration is the COSCO agreement with the Piraeus container terminal, which will be examined thoroughly in the respective chapter dealing with the Piraeus case, in which we will analyse extensively the influence of this factor to the competitiveness of a port.

Generally speaking, many researchers have dealt with the subject of finding out which factors influence a port's competitiveness, but most of them have researched it in global terms and very few preoccupied themselves with the Mediterranean Sea:

The subject that constitutes a crucial element for our thesis, that is, the factors which influence the port (container) competitiveness, these are strongly correlated with the port selection criteria (Yeo et al., 2008; Tongzon and Heng, 2005; Lirn et al 2003; Grosso and Monteiro, 2008; Huang et al. 2003).

- Malchow and Kanafani (2001) developed a model in which they tried to explain how the selection of port depended on different factors. Although in this article, they analyzed selection criteria for many types of commodities, they also mentioned some crucial factors, which influence the competitiveness of a container terminal. One important point was that port authorities along the east coast of the US decided to invest in port infrastructure and more precisely in bigger depth and longer length of berth in order to increase their competitiveness and to satisfy the Maersk request. In that way, the ports which could follow those developments, could attract bigger ships from competing ports. Other important selection criteria were also the geographical location of the port and the intermodal access.

- Itoh and Doi (2002) determined a number of variables, which influence the shipper's port of choice. In order to identify those variables the authors use database obtained from a survey. Some of the elements which influence the selection of the port are: 1) total cargo volume, 2) geographical location, 3) number of calls, 4) level of infrastructure and 5) number of the routs offered at the port. Nevertheless, in a more practical way, the authors are using a model which estimates the probabilities of choosing an alternative i (port) based on some variables[2]. Those are: 1) number of calls, 2) total throughput, 3) TEU's per berth at the port and 4) TEU's per crane.

- Huang et al. (2003) uses a Fuzzy Multi-criteria Grade classification (FMGC) model in order to measure the competitiveness of eight East Asian container terminals. In that study they also take under consideration efficiency and effectiveness indications by the help of methodologies such as Data Envelopment Analysis (DEA) and Game theories. In order to assess the competitiveness of the selected ports the authors use thirty-one variables. Some very important variables are: 1) labour quality, 2) container handling efficiency, 3) operational cost, 4) container terminal capacity, 5) time of container in the port, 6) geographical location of the port, 7) ratio and number of transshipment containers, 8) highway / rail connectivity, 9) number and depth of berths, 10) political, social and economical stability, 11) hinterland productivity, 12) land of logistics services, 13) EDI and shipping information, 14) land for container services, 15) level of automation in the terminal, 16) number of operational machinery and 17) port service cost.

- Lirn et al. (2003) uses an analytic hierarchy process (AHP) technique intending to identify the importance of factors that influence the transshipment choice for the Taiwanese ports. In that research, they collected almost fifty criteria from an extensive literature and they came to the conclusion that fourteen of those variables are the most important. More specifically, the mainly factors that they consider as influencing the competitiveness of a container port, which were

[2] According to the authors, those variables influence the competitiveness of a port.

used for their performance evaluation were: 1) total cargo volume, 2) port infrastructure (including water depth of the terminal, number of available berths and length of berths), 3) port facilities and equipment (superstructure), 4) intermodal links (includes highway, rail), 5) size of terminal, 6) logistic services, 7) proximity of competitive ports, 8) terminal safety and security, 9) terminal operation and risk management, 10) loading / unloading rate and berthing delay, 11) regulations and port administration, 12) ownership of terminal and port, 13) loading and unloading cost, 14) privileged treatment for the "bigger" carriers and 15) proximity to feeder ports, 16) deviation from main navigation routes. According to the authors, even if those criteria have been mainly analysed for transhipment ports, many of those variables (especially the first ones) influence also the selection of the gateway ports.

- Cullinane et al. (2004) in their research "*Container terminal development in Mainland China and its impact on the competitiveness of the port of Hong Kong*" made a remarkable analysis between the some characteristics of the port and the growth of market share in those ports. Taken as fact that the increase of throughput (TEU's) increases the competitiveness of a container port they showed that the demand was influenced positively (most of the times) when the following factors were increasing: 1) number of container terminals (increase of intra-port competition), 2) growth rate of economy, 3) number of calls, 4) number of feeder services and 5) number of sophisticated labour.

- In their investigation, Song and Yeo (2004) had identified a variety of factors which influence the overall competitiveness of the main ports in China. In this research, they focus in elements considering logistics and operational services as well as geographical location of the ports. The survey developed took under consideration a sample of 180 professionals such as shippers, ship-owners, terminal operations, researchers and academics. The result gave a list of 73 elements that influence the competitiveness of a port. In a second level, by the help of 70 specialists, they narrowed down this list into five most critical factors for the port competitiveness. These were: 1) total cargo volume, 2) port location, 3) service level, 4) port facility and 5) port expenses.

- Tongzon and Heng (2005) determined some key factors which influence the competitivness of the container ports. Those factors were based on the existing literature and are directry related with users' port selection criteria. More particularly the most important variables found were: 1) port cost (especially the cargo handling chargies), 2) the depth (in the approach channel and the terminal), 3) efficiency of port (terminal) operation, 4) reliability of servises (no strikes, minimum equipmnent breakdown etc.), 5) port selection preferences of shippers and carriers, 6) adaptabillity to the changing market envarionment, 7) connectivity of the port with other modes of transportation and 8) product (service) differentiation, (e.g. advaced information system).

- Cullinane et al. (2005), analysed the relative competitiveness of the container ports of Ningbo (China) and Shanghai. In this article, they determined some major elements which influence the competitiveness of the container ports. Those were: 1) cost of the port (cargo handling, storage, towage etc.), 2) depth of water, 3) inland transport infrastructure (mainly rail connection) and 4) quality of logistic services.

- Jacobs (2006), examined the inter-port competition between Long Beach and Los Angeles. In order to come in some conclusions, the author compared some crucial elements which influence the competitiveness. Those were: 1) the demand in terms of total TEU's for several years, 2) the number of terminals and their relation with the global liner operations, 3) size of the container terminals and 4) the number of direct-indirect employs of every port.

- One of the extremely few researchers relative with our range of selection was made from Dr Vlachos (2007). In this research, the author investigated the factors, which influence the competitiveness of container ports in the Mediterranean Sea. More specifically, he used an analytic hierarchy process (AHP) technique trying to identify the most crucial factors which influence the competitiveness in this market. According to him, the most important factors are: 1) the geographic location, 2) the demand (total cargo volume in TEU's), 3) transshipment ratio & the deviation of the port from main sea routs, 4) the logistics services provided by the port, 5) the total time that a ship stays in the port, 6) the information systems and especially the existence of EDI services, 7) the different types of cost and especially the cost for loading / unloading the containers, 8) the operation efficiency of the port, 9) the connectivity with the hinterland in terms of different transportation modes, 10) the productivity of the port, and 11) the marketing of the operators. Nevertheless, the author mentioned that for many of the above elements, it was not possible to collect the necessarily data for a comparison. For that reason he chose some more tangible characteristics of the ports based always on the above factors. More particularly, in order to benchmark the competitiveness[3] of the defined container market, the author chose the following elements[4]: 1) the 24/7 operation, 2) the existence of rail connection in the port, 3) the storage capacity of the port (total and reefer points), 4) the total terminal area (m^2), 5) the total traffic of the port and 6) some productivity indications (TEUs/quay crane, TEUs/m^2 etc.). We found this research very important for our methodologically approach and we will use all the previous elements later for the benchmarking of the container ports in the eastern and central Mediterranean region.

- The World Bank port reform tool kit of 2007 (module 3), mentions six key factors effecting the inter-port competition. The first factor is the geographic location, which includes the proximity to major maritime routes, the proximity to major consumption and production areas, the depth of the water and the connectivity of the port with other modes of transportation. The second key is the legal framework which includes, among other things, land and competition laws. The third variable is the socioeconomic climate and institutional structure of the port and has to do with the management structure of the port, and other factors such as the good relationship of labour the employers. The forth element is the prices (costs) and the efficiency of the port. The fifth element has to do with the financial resources of a port and how the existence of those recourses helps in the investments and the possible development of competitive advantage (in

[3] The benchmark is based on the inter-port competition level, which is true for the majority of the literature review that we examine.

[4] The author mentions that those characteristics are directly related to the demand and supply for container port industry. He also uses few more elements which we decided not to include it in this analysis.

comparison with other ports that are having limited resources). The sixth and last factor has to do with the reputation of the port, which plays an important role to the competitiveness of the port and is directly related with the five previous components.

- Pardali and Michalopoulos (2008) have measured the competitive position of the Piraeus container handling port. This is the first serious effort (in English) for the specific subject and are comparing the Piraeus port with other major ports of the Mediterranean Sea. This was also an inspiration for our research and the only directly relevant research approach of our subject. In that study, the researchers use thirty-five variables in order to evaluate the competitiveness of the selected ports. This evaluation includes variables from six different categories. The three biggest categories contain: 1) the demand (includes total container traffic, full containers, empty containers and total tonnage), 2) the supply (includes the number of container terminals, the number of berths, the total length of the berths, the surface of the container terminals, the number of cranes, the reefer points and the maximum depth) and 3) the applications to cargo (such as the cargo control, the staking control and the deposit control).

- The above published article was based in a PhD thesis of Pr. Michalopoulos (2006).The aforementioned author, first introduced a model which measures the competitive position of the Piraeus container handling port in a defined market. This model was based on the benchmarking technique and was implemented for the aforementioned port in the Mediterranean container market. He used exactly the same variables (as above) for his estimation and for the years: 2004 (analytically) and 2005-2006 (concisely).

- Yeo et al (2008), evaluated the competitiveness of Korean's and Chine's container ports taking under consideration seven aggregated parameters (port service, hinterland condition, availability, convenience, logistic costs, regional centre and connectivity). These parameters were an outcome of thirty-eight selection criteria, which they had identified before the beginning of their analysis. More specifically, the most important variables which they also had used in their evaluation were: 1) volume of total container cargo, 2) 24/7 service, 3) port congestion, 4) sophisticated and skilled labour in port, 5) size and activity in port hinterland, 6) availability of berth when the ship arrives in the port, 7) water depth in approach channel and berth, 8) Sophisticated level of port information, 9) stability of labour in the port, 10) inland transportation costs, 11) cost related to cargo and vessel entering, 12) free dwell time on container terminal, 13) port accessibility, 14) terminal productivity and 15) deviation from main sea routs.

- Another research for the main factors, which influence the decision of port of call had been made by the Grosso and Monteiro (2008). This paper focuses on the decision of freight forwarders in the selection of port. In this case, the author developed a questionnaire that they distributed to 26 freight forwarders, which operate in the port of Genoa. The data that was collected was analysed with the Factor Analysis method. The outcome was that the main elements that influence the port selection are: the connectivity of the port, the port productivity and cost, the electronic information and the logistics services of the port. Furthermore, some important additional criteria that influence the selection of

the port were: total time of container in the port, facilities of the terminal (in terms of infrastructure) and the transit time.

- Song and Panayides (2008), in their research "*Global supply chain and port / terminal: integration and competitiveness*" mention some crucial factors which influence the competitiveness of a container port/terminal. Some of those elements are directly (or indirectly) linked with the logistic services provided by container port/terminal. For instance, a few crucial elements are: 1) prices, 2) connectivity with other modes of transportation, 3) existence of Container Freight Station (CFS), 4) information systems and especially EDI and 5) other services for the empty containers such as the container cleaning and repair services.

- Chang et al. (2008) basing their analysis on survey data; identified some important criteria, which influence the port of choice and consequently the competitiveness of the container ports. The port choice variables that were considered as the most important were: 1) geographical location, 2) total cargo volume, 3) terminal handling cost, 4) berth availability, 5) transhipment volume, 6) frequency of feeder services, 7) port reputation, 8) water draft, 9) connectivity with other modes of transportation, 10) import and export cargo balance and 11) port dues.

- Pallis and Vitsounis (2009) in their article "*Greek container port competitiveness. Perspectives of user do matter*", they analysed some crucial elements which influence the competitiveness of the Greek container ports: 1) demand (total throughput in TEU's), 2) productivity, 3) availability in number of berths, 4) geographical location, 5) costs of the port (all the types), 6) safety, 7) infrastructure of the port (on terms of depth, area of container terminal, storage area, etc.) and 8) total time of a vessel spending in a port. Finally, the authors mention that the development of intra-port competition will stop the monopolistic situation and will create a duopoly (case of Piraeus) regarding the number of terminal operations. However, even this new status quo will provide the users with alternative solutions and will shift positively the competitiveness of the port. The aforementioned authors mention that for the case of Piraeus, if the number of container terminals (operators) was bigger than two, then the competitiveness would increase even more. Nevertheless, this duopoly is a necessarily step for the improvement of the competitive environment.

In the table below, we are providing most of the above data in a cumulative way. However, some of the variables stay out of the presentation, not necessarily due to their lack of importance, but because they are too many in order to be presented in cumulative way. On the other hand, however, few factors are presented individually (e.g. size of terminal) and integrated also into some groups (infrastructure). We decided to present those factors in that way, in order to be able to clearly support some of our variables, which will be used later in the benchmarking analysis. Moreover, since many of those factors exist also in the original table, we left them as they were. We have to make clear that the table (2.1) bellow, includes a variety of authors from previous researchers about the same area and for that reason, we are using them for a more complete evaluation of the variables. This table is based on Lirn et al. (2003) and some changes in the name of variables have been made, taking care to portray the same content. Finally, some researchers have been removed due to the fact that their analyses are out-dated.

Table 2.1: Factors affecting the competitiveness of the container ports

Criteria / Authors	Murphy et al. (1989)	Browne et al. (1989)	Haynth (1995)	Villalon (1998)	Thomas (1998)	Porcari (1999)	Fleming & Baird (1999)	Baird (2000)	Brooks (2000)	Frankel (2001)	Makhow & Kanafani (2001)	Ioh & Doi (2002)	Huang et al. (2003)	Lirn et al. (2003)	Cullinane et al. (2004)	Song & Yeo (2004)	Tongzon & Heng (2005)	Cullinane et al. (2005)	Jacobs (2006)	Michalopoulos (2006)	World Bank (2007)	Vlachos (2007)	Grosso and Monteiro (2008)	Pardali & Michalopoulos (2008)	Yeo et al. (2008)	Song & Panayides (2008)	Chang et al. (2008)	Pallis & Vitsounis (2009)
Available number of berths					√								√	√	√				√	√				√	√		√	√
Cost for cargo handling, storage and transfer	√	√		√					√					√		√	√	√			√	√	√		√	√	√	√
Cost related to port dues and port services (pilotage, towage, mooring etc.)		√							√				√			√	√	√			√	√	√				√	√
Container handling efficiency (& operation efficiency in general)	√	√		√									√				√				√	√						
Depth of the port (& in approach channel)				√							√		√	√			√	√	√	√	√			√	√		√	√
Distance from main ocean (& inland) routs											√										√	√			√			
Geographical advantage (due to the location)	√			√		√	√		√			√	√			√					√	√					√	√
Free dwell time																									√			
Frequency of cargo loss and damage																									√			
Frequency of feeder services		√							√	√					√	√											√	
Frequency of large container ship calling the port		√	√							√															√			
Labour problems (mainly strikes)								√									√						√					
Level of infrastructure	√		√	√	√	√					√	√		√					√	√			√	√				√
Level of superstructure (including also cargo handling equipment)	√				√				√							√				√			√	√				
Loading / discharging rate		√			√				√					√														
Logistic services provided by the port (terminal)													√	√		√		√				√	√					
Low cost services	√	√		√					√																			
Numbers of calls (direct or/and transhipment)		√						√				√	√	√											√			
Related business operation						√				√																		
Recognition and reputation of port																					√				√		√	

Source: Lirn et al. (2003), adapted and expanded by the writer

Part 1 / 2

Table 2.1: Factors affecting the competitiveness of the container ports (continue)

Criteria / Authors	Murphy et al. (1989)	Browne et al. (1989)	Haynth (1995)	Villalon (1998)	Thomas (1998)	Porcari (1999)	Fleming & Baird (1999)	Baird (2000)	Brooks (2000)	Frankel (2001)	Makelow & Kanafani (2001)	Itoh & Doi (2002)	Huang et al. (2003)	Lirn et al. (2003)	Cullinane et al. (2004)	Song & Yeo (2004)	Tongzon & Heng (2005)	Cullinane et al. (2005)	Jacobs (2006)	Michalopoulos (2006)	World Bank (2007)	Vlachos (2007)	Grosso and Monteiro (2008)	Pardali & Michalopoulos (2008)	Yeo et al. (2008)	Song & Panayides (2008)	Chang et al. (2008)	Pallis & Vitsounis (2009)
Port accessibility (land and sea)			√				√																					
Port operation / working days & hours (24/7 service)	√	√	√		√				√											√		√		√	√			
Port berthing time		√			√									√														
Port security	√													√						√				√	√			
Port safety														√						√					√			√
Port service coverage									√																			
Port organisation-management and terminal ownership							√							√							√				√			
Privilege contract to carrier						√																	√					
Port (terminal) productivity		√	√				√							√								√	√		√			√
Proximity to alternative competitive ports														√														
Regulations														√														
Size of terminal														√					√	√		√		√	√			√
Sophisticated level of port information (EDI etc.)			√							√			√							√		√	√	√	√	√		
Sophisticated and skilled labour													√		√										√				
Intermodal link / network (includes highway, rail & bargees)	√			√						√			√	√			√	√		√	√	√				√	√	
Total cargo volume (TEU's)	√			√								√		√		√			√	√		√		√	√		√	
Total time of containership in the port													√									√	√					√
Time on the route								√	√																			
Transit time		√					√		√														√					
Zero waiting time service																									√			

Source: Lirn et al. (2003), adapted and expanded by the writer

Part 2 / 2

2.4 Important remarks and conclusions of the literature review

From the above analysis, we can come up with some important competitive criteria which we will use later for the benchmarking analysis and for the rest of our study.

- Traditionally, the most commonly used criteria for the identification of the competitiveness in a container port was its throughput (Song and Yeo, 2004). As we have seen from our previously analysis, a remarkable number of writers (Itoh & Doi, 2002; Lirn et al., 2003; Cullinane, et al., 2004; Jacobs, 2007; Michalopoulos, 2006; Vlachos, 2007; Pardali & Michalopoulos, 2008; Yeo et al., 2008; Chang et al., 2008) support that the total cargo volume is a scientifically appropriate tool for the identification of the competitiveness of a container terminal. In many cases, however, this criterion has been used as the only factor for the measurement of competition and, in our opinion, this was not the most appropriate approach.

- According to Lengen and Pallis (2004), the implementation of intra-port competition increases the total competitiveness of the harbour (inter-port level). This type of competition is directly linked with the number of container terminals in a port. In that way, if a port develops more than one container terminals (and created intra-port competition), then the port will shift from a monopoly situation into more competitive forms of market (Pallis & Vitsounis, 2009; World Bank, 2007). For that reason, many port authorities of medium[5] container ports are trying to increase their competitiveness with the construction of new container terminals and the concession of those terminals into private companies (World Bank, 2007). So, in general (and given that fact that the necessary demand exist), the increase in number of container terminals leads to a positive shift on the port competitiveness (Jacobs, 2007).

- According to a remarkable number of authors (such as Brooks, 2000; Michalopoulos, 2006; Vlachos, 2007; Pardali & Michalopoulos, 2008; Yeo, et al., 2008) the operation of a container terminal (in terms of working days and hours) is a crucial factor for the port competitiveness. The 24/7 service for the vessels, has been broadly implemented, during the last years. However, the 24/7 operation for the gate has been started gradually to increase its importance (in terms of competitiveness) only during the last years (Athanasakopoulou, 2006). Of course, the existence of the 24/7 operation for the gate is more crucial for a getaway port rather than a hub port.

- The sophisticated level of port information is also an important factor for the port competitiveness (Grosso & Monteiro, 2008; Yeo, et al., 2008). In reality, many applications which exist provide a sophisticated level of port information. Nevertheless, we have seen from the literature that in many cases (Huang et al., 2003; Michalopoulos, 2006; Vlachos, 2007; Pardali & Michalopoulos, 2008; Song & Panayides, 2008), the existence of EDI (Electronic Data Interchange) system has been used in order to measure the quality of the port information.

[5] In terms of cargo volume

- We have concluded that the depth of a container terminal is a determinant factor which influences the competitiveness of a port (Malchow & Kanafani, 2001; Huang et al., 2003; Lirn et al., 2003; Tongzon & Heng, 2005; Cullinane et al., 2005; Jacobs, 2007; Michalopoulos, 2006; World Bank, 2007; Pardali & Michalopoulos, 2008; Yeo et al., 2008; Chang et al., 2008; Pallis & Vitsounis, 2009).

- The available number of berths is an important element for the competitiveness of a port (Lirn et al., 2003; Cullinane et al., 2004; Jacobs, 2007; Michalopoulos, 2006; Pardali & Michalopoulos, 2008; Yeo et al., 2008; Chang et al., 2008; Pallis & Vitsounis, 2009). If a containership doesn't have an available berth when it enters the terminal, then it will have to wait and remarkable costs and delays will be created. So, when a terminal has more berths (with the appropriate equipment for the loading / discharging procedure) then it is secured about any possible unmet service (Huang et al., 2003). Due to that reason, the availability of berths is strongly correlated with the number of berths.

- The connectivity of a port with other modes of transportation is a crucial element for the container terminal (Huang et al., 2003; Lirn et al., 2003; Tongzon & Heng, 2005; Cullinane et al., 2005; World Bank, 2007; Vlachos, 2007; Song & Yeo, 2004; Chang et al., 2008). It has nevertheless, higher value for a getaway port than for a hub port.

- The logistic services geared by the container terminal influence dramatically the competitiveness of a port (Huang et al., 2003; Lirn et al., 2003; Song & Yeo, 2004; Cullinane et al., 2005; Vlachos, 2007; Grosso & Monteiro, 2008). More specifically, if a container terminal provides added value services (such as loading of loose cargo into a full cargo) then it increases the flexibility for a client (shipper). According to Song and Panayides (2008) and the World Bank (2007), the container cleaning services and the container repair services are some of the logistic services which could be provided by a container terminal.

- The size of a container terminal plays crucial role for the competitiveness of the port according to some authors (Lirn et al., 2003; Jacobs, 2007; Yeo et al., 2008; Pallis & Vitsounis, 2009). Moreover, three researches (Michalopoulos, 2006; Vlachos, 2007; Pardali & Michalopoulos, 2008), support the same thing, but they benchmark the competitive position of a container port by adding the surface of all the container terminals thus producing one total number. According to these authors, a high total surface is an indication for higher level of competition.

- Considering the security of a port, a adequate number of researchers support that it is an important element for the port competitiveness (Lirn et al., 2003; Michalopoulos, 2006; Pardali & Michalopoulos, 2008; Yeo et al., 2008). For the security of the port facility, ships, containers and labour, many systems and regulations have been developed during the last decades. According to (Michalopoulos, 2006; Pardali & Michalopoulos, 2008), one method for the recognition of security level of a port is the examination of

existence of ISPS (International Ship & Port Facility Security) code in each container terminal (port).

- Another traditionally important element, which influences the competitiveness of container terminals is the level of infrastructure. According to World Bank (2007), the infrastructure includes among other things: port entrances, navigable sea routes, total area of the terminal, quay walls and docks. Some decades ago, the increase of infrastructure in terms of size was extremely crucial for the achievement of competitive advantage. Nowadays, it is not considered as such an important factor and the terminal operators are most of the times looking at how efficiently they are using their infrastructure and not how ”big” (in term of size) it actually is. Nevertheless, until these days, a sufficient level of infrastructure influences positively the competitiveness of a port (Malchow & Kanafani, 2001; Itoh & Doi, 2002; Lirn et al., 2003; Jacobs, 2007; Michalopoulos, 2006; Grosso & Monteiro, 2008; Pardali & Michalopoulos, 2008; Pallis & Vitsounis, 2009).

- The superstructure and handling equipment in a container terminal has been proved from the above examination that is an element which influences the competitiveness of a port (Brooks, 2000; Song & Yeo, 2004; Michalopoulos, 2006; Grosso & Monteiro, 2008; Pardali & Michalopoulos, 2008). According to World Bank (2007), the superstructure includes: repair shops, warehouses, Container Freight Stations (CFS), staking areas, quay and yard gantries etc. Like in the case of infrastructure, an increase in terms of size-number of the superstructure have implemented during the last decades in order to increase their competitiveness. Nowadays, the terminals prefer to increase the utilization and productivity of their terminals in order to operate more efficiently their equipment and facilities. Even in these cases however, many terminals (as we will see later), invest in superstructure and cargo handling equipment in order to increase their competitiveness. So, even nowadays the superstructure and handling equipment plays an important role in the competitiveness of a container port.

- As we show above, the superstructure influences the competitiveness of a port. According to the world bank (2007), part of the superstructure is the staking area (total and reefer points). In three researches (Michalopoulos, 2006; Vlachos, 2007; Pardali & Michalopoulos, 2008), the authors have calculated the total staking area (in TEU’s) and the number of reefer points (in TEU’s) in order to benchmark a factor which influences the container port competitiveness.

- The productivity of a container port is, according to the literature, an important indication for the competitiveness of a container port (Fleming & Baird, 1999; Lirn et al., 2003; Vlachos, 2007; Grosso & Monteiro, 2008; Yeo, Roe, & Dinwoodie, 2008; Pallis & Vitsounis, 2009). In order to measure the productivity however, it is necessary to collect many different types of information, which the port operations do not share most of the times. Many authors use more simplified methods in order to measure productivity indications of the ports. From the already examined literature, Dr Vlachos

(2007) and Itoh and Doi[6] (2002) have used some indications for the container port productivity (TEUs/quay crane[7] & TEUs/m^2 [8]etc). Moreover, a few more authors (Le-Griffin & Murphy, 2006; Pardali, 2007), have developed the same productivity indications in their studies.

- In order to improve the handling equipment and superstructure, an entirely new progress has created in the terminals. The automation has been mainly implemented in the yard area (e.g. RMGs) and in the horizontal transportation (e.g. AGVs) and is very beneficial because it reduces among other things, accidents, labour cost and the unpredictability of operations (Rijsenbrij & Rijsenbrij & Saanen 2010). However, we will examine if any serious level of automation exists in the eastern and central Mediterranean container ports.

- Finally, as we will see in chapter 6, a very crucial development that positively influences the competitiveness of a port is the change of management in a container terminal. According to Tongzon & Heng (2005), the private participation in a container terminal increases directly the efficicency of the port and indirectly its competitiveness.

[6] These authors have used only the TEU's/m^2.
[7] Intensity of equipment operation
[8] Intensity of port space

Chapter 3: Overview of methodologies for the identification and measurement of port's competition

3.1 Introduction

In this chapter we will present an overview of the main methodologies, which have been used in the past in order to indentify and measure intre-port competition. Some of those methodologies have proven capable of measuring intra-port competition as well, but this is not the subject of our thesis. This chapter is divided into two parts. In the first part we present two methodologies for the identification of the port competition (Porter's theory and analysis of variance), while in the second part we present three methodologies for the measurement of the port competition (market shares, strategic positioning analysis and benchmarking technique). We have to make clear that almost all of the aforementioned methodologies have been also used in other industries.

3.1 Methodologies for the recognition of port competition

3.1.1 Porter's Five Forces

Michael Porter (1980) developed the theory of five forces to determine the attractiveness of a market. "The reporting of these forces was the microeconomic environment in comparison to the macroeconomic environment" (Pardali, 2007). The five forces comprise of the attributes that have impact on the ability of a company to serve customers and making a profit. A change in any of these forces requires the company to reassess the market. According to Porter (1980), the four forces are: "a) the bargaining power of customers, b) the bargaining power of suppliers, c) the threat of newcomers and d) the threat of substitute products". All these forces combined together can influence a fifth power, which is the level of competition in an industry.

Figure 3.1: The five forces of Porter's theory

Each of these forces has different determinants as follows:

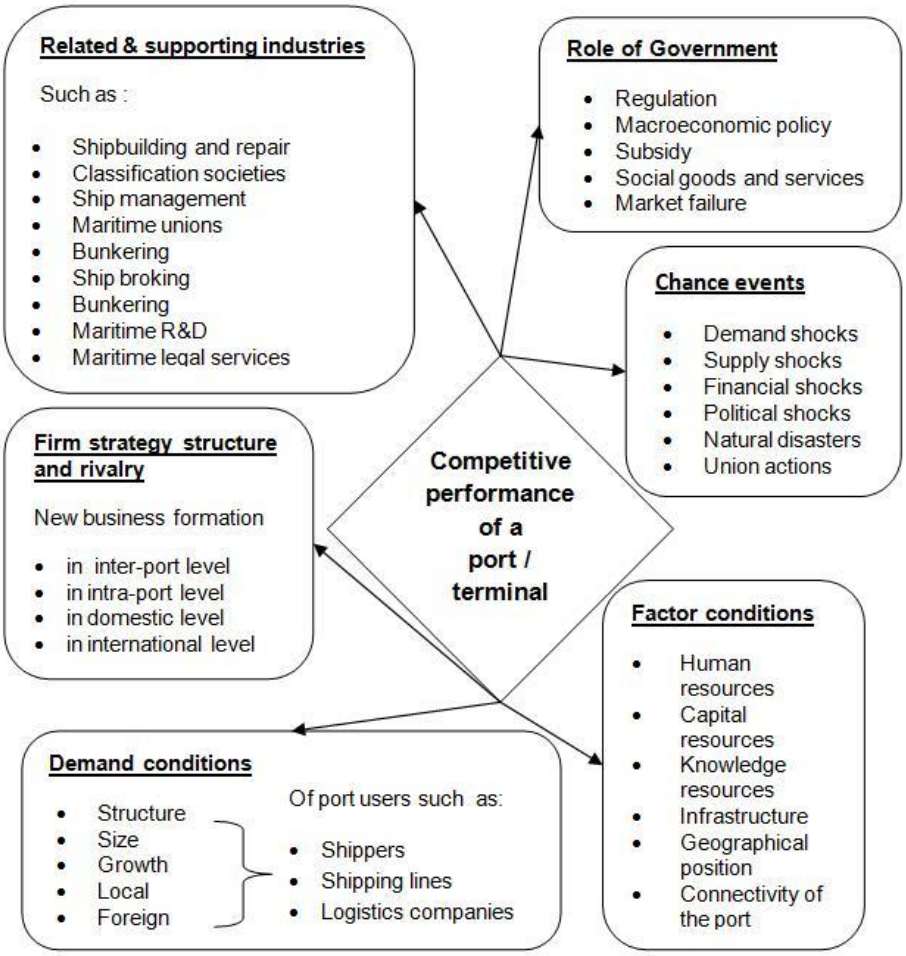
Table 3.1: determinants of Porter's five forces

(1) The bargaining power of customers The determinants of the bargaining power of customers are: • The concentration of buyers in the concentration ratio of the firm. • The power of negotiation. • The volume of buyers. • The changing costs of buyers in relation to the changing costs the company. • The availability of information buyers. • The reverse integration. • The availability of existing substitute products. • The price sensitivity of buyers. • The value of the total market.	**(2) The bargaining power of suppliers** The determinants of bargaining power of suppliers are: • The changing costs of the suppliers in relation to the changing costs of the company. • The degree of differentiation of inputs. • The presence of substitute inputs. • The concentration of suppliers in relation to the concentration ratio of the firm. • The threat of integration by suppliers in relation to the threat of integration of the businesses. • The cost of inputs on the selling price. • The importance of volume to the supplier.
(3) The threat of new entrants The determinants of the threat of new entrants are: • The existence of barriers to entry. • Economies of scale. • Differences of exclusive products. • The legislation on brands. • Conversion costs. • The capital requirements. • Access to distribution. • The absolute cost advantages. • The benefits of learning curves. • The expected return. • Government policies.	**(4) The threat of substitute products** The determinants of the threat of substitute products are: • The tendency of buyers to substitute. • The relative price performance of substitutes. • Conversion costs buyers. • The perceived level of product differentiation.
(5) The intensity of competition of competitors The determinants of the intensity of competition by the competitors are: • The power of buyers. • The power of suppliers. • The threat of new entrants. • The threat of substitute products. • Industrial development. • Overproduction of the industry. • The barriers to exit. • Diversity of competitors. • The informational complexity and asymmetry of information. • Brand Legislation. • The fixed cost allocation per value added.	

source: Porter (1990)

Porter (1990), argued that “the competitive advantage is created and supported through a limited development”. He showed that the five characteristics of the "diamond" of other countries or regions do not participate in the development of local competition. This distinction actually introduced the concept of development of competition, only at the local level, or among companies operating in specific geographic areas.
Rugman and Verbeke (1993), based on Porter’s Diamond, developed an extensive work which introduced the local, regional and global level of each edge of the diamond (Buyers, Suppliers, Potential entrance, Regulation, Substitutes). After all, the competition can develop both locally and regionally, whereas the development depends on interactions between different geographical areas. The authors demonstrated that each factor of the diamond is estimated to contribute to the development of competition in different geographical levels. This aspect came to be called “extended diamond” (Extended diamond). A subsequent investigation in this topic has been done by Yap & Lam, in which they presented a diagrammatic representation of the extensive diamond in the area of port industry (figure 3.2).

Figure 3.2: The extended "diamond" of Porter on the port industry



source: Yap & Lam (2004), Pardali (2007)

Based on the extended diamond, the competitiveness of a port depends on the following conditions (Yap & Lam, 2004):

1. On the supporting industries which include the businesses that are related, directly or indirectly, with the port and produce products for the port cluster.

2. On the government, which (among others) sets the rules, contributes to the construction of infrastructure and intervenes in the market, producing products wherever businesses cannot.

3. On the demand, depending on the structure, the size and the growth of customers. Main customers are the shipping companies, the logistics companies and the shippers who operate both locally and globally.

4. On the conditions of the production processes, including human resources, capital resources, natural and knowledge resources.

5. On unpredictable events which may be related to the broader socio-political and economic developments, local or global.

6. Finally, on the firms' strategy and the strategies of competitors.

All together the aforementioned factors interact and shape the competitiveness of the port/terminal.

Porter's theory did not function as a method for measuring competition, but created the necessary theoretical framework on which subsequent researchers and analysts based their researches, when focused on specific economic problems. Especially for ports, the contribution of Porter's theory was crucial because at the time he analyzed his theory, significant changes were developing at the global port industry. These changes dealt primarily with the change in ownership of ports and the operation of container terminals under the private companies.

3.1.2 Analysis of Variance (ANOVA)

Another method broadly implemented in the shipping industry is the Analysis of Variance (ANOVA). This methodology has been implemented in most of the cases for the measurement of the efficiency in co-operation with the Data Envelopment Analysis (DEA). However it can also be implemented in order to identify the ports competitive position in a defined market (Huybrechts et al. 2002).
Analysis of variance (ANOVA) is a statistical method which examines if a continuous in nature variable or its mean values differ because of the effect of one or more categorical variables (Gnardellis, 2004). The continuous variable is the response, whereas the categorical variables are the predictors or factors. For example, in a clinical trial of patients with high cholesterol, ANOVA procedure could be used to compare the levels of cholesterol of three different age groups. Cholesterol would represent the response variable, while the age group represents the independent variable, or factor of interest.

Depending on the number of criteria taken under investigation, the analysis of variance is divided into three classifications (Hocking, 2003):
(i) Analysis of variation by one classification criterion[9].
(ii) Analysis of variance by two classification criteria.
(iii) Analysis of variation by three classification criteria, or otherwise analysis of the Latin square.

One-Way ANOVA

One-way ANOVA evaluates the effect of a single categorical variable (factor) on a single continuous variable (response). Suppose that we have k random and independent samples of size $n_1, n_2, ..., n_k$ with respective mean values $\bar{x}_1, \bar{x}_2, ..., \bar{x}_k$ and standard deviations $s_1, s_2, ..., s_k$. Suppose also, that for the respective populations, the distributions of the respective size are normal with common variance σ^2. In this case, statistical testing of the mean values can be formulated with the following null hypothesis:

$$H_0 : \mu_1 = \mu_2 = ... = \mu_k$$

and its alternative

$$H_1 : \text{At least two of } \mu_1, \mu_2, ..., \mu_k \text{ differ each other}$$

To test the null hypothesis, the variance in k population groups is compared to the variance between population means in relation to the total population mean (grand mean).

The variance within k population groups can be calculated as follows:

$$SSW = \sum_{i,j} \left(x_{i,j} - \bar{x}_i \right)^2 = (n_1 - 1)s_1^2 + ... + (n_k - 1)s_k^2$$

where $i = 1,2,..., k$ and j all members of each sample. This quantity is called within-groups sum of squares.

[9] For our later analysis we will use the analysis ANOVA by one classification criterion.

The variance between groups (considering groups' means as observations) can be calculated as follows:

$$SSB = \sum_i n_i \left(\bar{x}_i - \bar{x}\right)^2$$

where $\bar{x}$ is the total sample mean.

The previous quantity is called between-groups sum of squares.

Total variance of all values around the total population mean is evaluated by the formula:

$$TSS = \sum_{i,j} \left(x_{i,j} - \bar{x}\right) = (n-1)s^2$$

Where $n = n_1 + n_2 + ... + n_k$ is the total sample size and s the standard deviation of values in the total sample. This sum is called total sum of squares.

The three, previously mentioned quantities SSB, SSW and TSS, are related to one another in the following way:

$$TSS = SSW + SSB$$

Null hypothesis testing is based on the comparison of variance between-groups to variance within-groups. To reject the null hypothesis, thus to consider that group means are not all equal, distributions within each group should differ from one another. Thus, each group should be clearly differentiated from the rest, a treaty practically ensured by the existence of small variance within each group and large variance between groups. Based on the definitions of the respective variances that we have already given, the fraction:

$$\frac{\text{Variance between groups}}{\text{Variance within groups}}$$

should be as large as possible.

If in the previous fraction the numerator and the denominator are respectively replaced by

$$s_B^2 = SSB/_{k-1} \ (\text{Mean sum of squares between groups})$$

and

$$s_W^2 = SSW/_{n-k} \ (\text{Mean sum of squares within groups})$$

The quantity:

$$F = \frac{s_B^2}{s_W^2}$$

(provided that the null hypothesis holds) follows F distribution with $k-1$ and $n-k$ degrees of freedom.

But, F distribution is an asymmetrical bell-shaped distribution that begins from zero and extends asymptotically to the positive values of the values axis (Gnardellis, 2004). The area that includes just 5% of the distribution values and lies in the right edge, defines the rejection area $a = 0.05$, for the null hypothesis $H_0 : \mu_1 = \mu_2 = ... = \mu_k$.

If the probability for F distribution to take a value larger or equal to the respective value F_s - which comes from the sample data - is very small, thus

$$P[F > F_s] \leq 0.05$$

then, the null hypothesis is rejected and the alternative H_1, is accepted.

The following three assumptions must be fulfilled for the previous test of hypothesis procedure to be valid (Gnardellis, 2004):

- Samples must be randomly and independently selected,
- the distribution of the response variable is normally distributed in each population,
- The variance of the response variable is the same in each population.

The above method (one-way ANOVA) can be implemented in order to identify the competitive position of different ports in a defined market (Huybrechts et al. 2002). In this case, the categorical variable (factor) could be the port, with *n* levels (*n* ports) and the response variable could be the traffic volumes (TEUs) of each port for a time period. With the analysis of variance we can observe if there are significant

differences in the traffic volumes considering the examined ports. Later we can group those ports by using some other methodologies, as we will see in chapter five. Nevertheless, we don't have to forget that this method can be used only as an identification of port competition, because the factors that comprise the port competition are numerous and cannot be limited to a single variable, such as (for instance) the overall throughput in TEU's.

3.2 Methodologies for measuring of port competition

3.2.1 The method of market shares

One of the easiest and traditionally implemented methods for measuring the competition in an industry is the marker share method. This method is applicable to all economic areas and by extension, to the port industry. According to the economic theory, taken as given that "all other things being equal" (ceteris paribus) the competition of a market increases when more companies enter the industry. In this case, the concentration can be measured with the market share method (Pardali & Stathopoulou, 2005). Under this method, the competition degree of each port is equal to the share held each time. In order to calculate the market shares, we define the market, in which the selected port operates and we attempt to quantify the data of the feature we want to measure in each port of the specific market. The sum of all data points for each harbor, leads the overall market. "The percentage contribution of each port in the whole market is the share of each port and the degree of competition" (Goulielmos, 2002). This method is fairly quick and easy in execution, but has the disadvantage that it does not take under consideration the type of the market and some important competitive parameters, such as information about the supply of a port as well as the quality of the port services.

3.2.2 Strategic Positioning Analysis or SPA method (PPA, SSA, PDA)

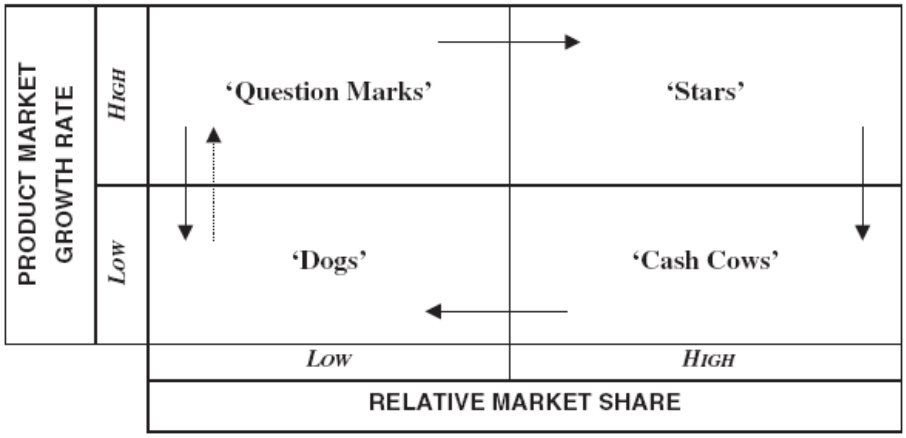
This method consists of three sub-analyses, the Product Portfolio Analysis (PPA), the Shift - Share Analysis (SSA) and the Product Diversification Analysis (PDA). The usage of the above method can provide us a) with answers concerning the total strategic position of ports, b) with suggestions on their general strategic position, as well as c) with strategy formation and d) decision-making on port development. The SPA illustrates the operation of ports and traffic classifications within ports, in what concerns aspects like market share, growth rate, diversification and value added. The SPA has to be used having in mind the port's position considering value-added originated by the various traffic categories.
This is the most common method for measuring competition at the ports. According to this method, we calculate the market share and growth rate for each type of cargo that ports manage (the growth rate is the average annual increase noted in each

type of goods that ports manage) and calculate the difference observed during a time period.
Then compare the factors that constitute port operation, initially among them and then comparing the other main ports involved in the chosen market. The advantage of this method is that it provides a universal methodology for the objective determination of port competition and is totally based on the flow of cargo from the ports.
The main disadvantage of this method is that it ignores the extension to which the different categories of port traffic are involved in the creation of value added (Beth, 2000). Yet it does not take into account the productive capacity of the port and the quality of port services.

3.2.2.1 Product Portfolio Analysis (PPA)

The analysis of PPA was designed by Boston Consulting Group (BCG) in order to determine the strategic planning at the enterprise level. It allowed the interpretation of results of operation and organizational units of the firm, using only two variables: (a) market share and (b) growth index (Teurelincx, 2000). Figure 2 shows the analytical philosophy of PPA.

Figure 3.3: Boston Consulting Group-Matrix



source: Haezendonck et al, (2006); quoting from Dibb et al.,(1991)

"Question Marks" (high growth rate and small market share), in a traditional business framework, are SBUs, which require substantial investments in order for them to create market share, since they are mainly characterized by their high growth rate. In a case where we have a significant market share with a significant growth rate, then we characterize this product as a 'Star', which is considered the 'hit' position. 'Cash cows' (large market share and small growth rate) produce money, and these products usually finance the 'Question marks' of the company. The products which belong to the place of "Dogs", have small inherent profit potential, since they are not able to produce adequate cash flows.

The choice of the PPA analysis, the use of market share and growth rate as a hopeful method of analysing the competitive position of ports, has the following advantages:
• Includes techniques are relatively easy to calculate and presented.
• All the necessary elements for the analysis are easy to assemble.
• It is a global reliable method that is particularly important for assessing the needs of the ports infrastructure.

According to Haezendonck (2006) we can use this tool to the port sector, if we consider the diverse traffic groupings, e.g. liquid bulk, dry bulk, containers, Ro-Ro (roll on, roll off) and regular cargo and, therefore, we could conceive them as 'strategic traffic units' (STU's). In such a case, each significant traffic flow in any port can be expressed in terms of relative market share and traffic growth.
In any case, when portfolio analysis is applied to port traffic structures, it is not certain that we will get justifiable answers; for instance if we aim to achieve increased cash flow or we want to present ways to increase market share, the traditional application of the tool will not produce well-founded answers. However, portfolio analysis offers both port authorities and port operators to profit supplying them with practical and functional approaches concerning the configuration of the port's traffic flows and compare it to the port's competition. It also provides a relative portrayal of previous-years performance as well as it can be the initial stage for the strategic planning of future asset allocations that influence traffic portfolio (Haezendonck et al, 2006).

3.2.2.2 The Shift – Share Analysis (SSA)

The second tool of the SPA method is the Shift-Share Analysis. According to this analysis, the flow of goods from one port are broken down by type (such as general merchandise, dry bulk cargo, bulk liquid cargo, etc.). This analysis examines the evolution of the flow of goods by type and measure the contribution of each type of cargo on all goods handled by ports. The analysis of the composition and evolution of traffic flows in a port, is seen at the broader context of competition between ports, creating the market shares of each port for each category of goods.
In this way, the shift share method determines the degree of attraction (growth or reduction) of "special" loads (actual categories of goods) under the influence of operating ports (Haezendonck et al, 2006). Determining the degree of effect influence on the operation of the ports achieved by measuring three features (Barff and Knight., 1998):
• The share-effect.
• The commodity-shift and
• The competitiveness-shift.

The effect of the share (share effect), shows the dynamic growth (Loveridge et al., 1999) of a type of cargo in a port, assuming that the overall share of the port remains stable. It describes the changes to the amount of traffic on the assumption that all categories of traffic are involved at the same proportion to the evolution of the total traffic of the port (Gazel et al., 1998). The difference between actual growth and estimated share effect, reflects the increase or decrease in market share and is presented as a shift-effect (Wadley and Smith, 2003).

The commodity effect indicates the degree of specialization of a port, on particular categories of goods on which this port presents increased traffic (Wang, 1998). Therefore, it includes the effect of modulation of the categories of traffic on every port. Positive impact is presented in a port, when the port has specialized in a field of commodity (i.e., containers). Negative impact immerges when the structure of the port traffic is inferior.

Table 3.2: Graphical representation of SSA-results

COMPETITIVENESS-SHIFT (INDEX)		
Joker	Envied achiever	COMMODITY-SHIFT (INDEX)
Waning idler	Sleeping beauty	

source: Haezendonck et al., (2006)

The competitiveness effect represents the effort of a port to attain a larger market share in the category where its traffic presents the best results (Sleuwaegen and Goedhuys, 2003). It shows when there is improvement or deterioration of the market share in various categories of traffic. This effect reflects the strength or weakness of the overall market share of a port through an increase or decrease of share on various categories of traffic.

3.2.2.3 Product Diversification Analysis (PDA)

The third part of the SPA method analyses the difference observed in a port during the progression of time. The traffic diversification index calculated, determines the relative proportion of types of traffic of a port and assesses the composition of this activity. This index, known also as concentration index (Notteboom, 2010) analyses the types of traffic. The algebraic expression of the diversification index is (Haezendonck et al., 2006):

$$D_j = \frac{\sum_{i=1}^{n} P_{ij}^2}{\left[\sum_{i=1}^{n} P_{ij}\right]^2} \leq 1$$

where:
Dj = diversification-index for port j
Pij= traffic volume i of port j

A Price index of 1, means the absolute specialization of a port to a particular class of traffic (Sutton, 1999). Equally distributed between the categories of traffic of a port, occurs when the indicator takes the value of 1/n, where n is the number of classes of traffic. Consequently, small price shows a proportional breakdown of traffic to all categories of a port, while the lowest value of the index shows in absolute proportionality the categories of traffic.

3.2.3 The Benchmarking technique

During the following pages, we will have an extensive analysis about the benchmarking technique. In the beginning, we will examine the concept and the objectives of the benchmarking, Later we will study the types and the advantages of this technique. After this, we will provide a literature review of applications of the benchmarking technique in the transport sector. Finally we adopt the benchmarking technique for the measurement of the port competition.

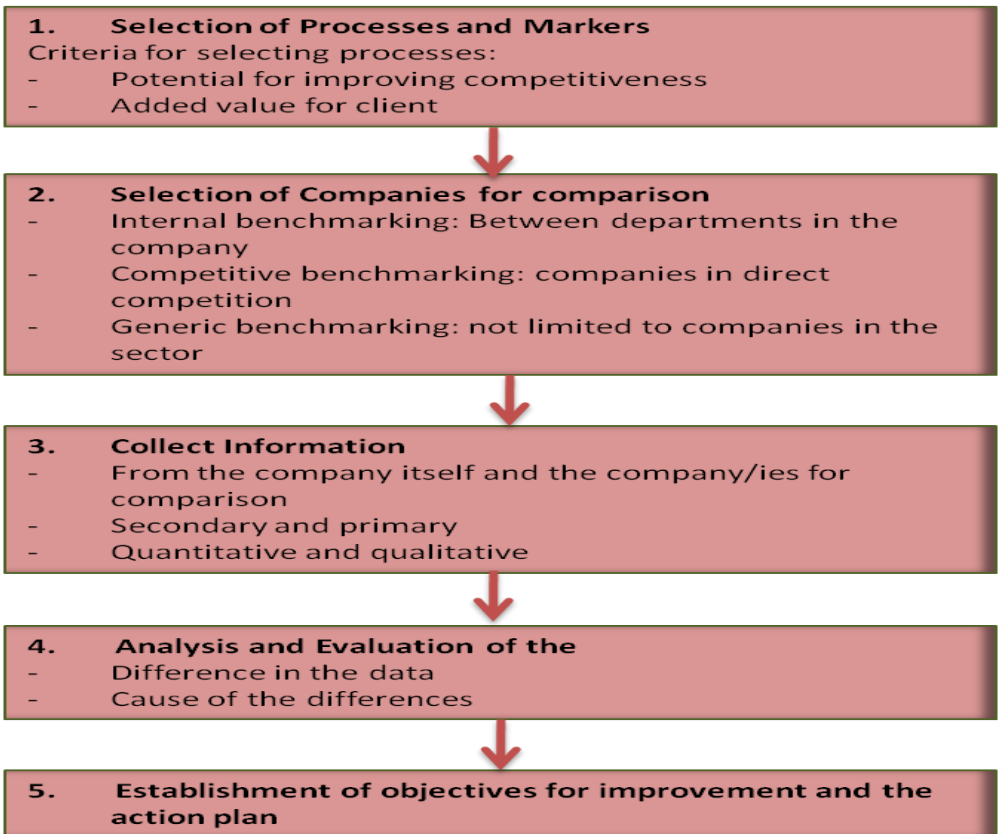
3.2.3.1 The concept of Benchmarking

Benchmarking is an everyday activity for quite a large number of people, which if we would like to put it in simple terms is a way to compare performance against another similar activity, in order to examine if we are getting the best results or the best value for a particular item. Literature provided the following definition: *"Benchmarking is a continuous systematic process for evaluating the products, services and work processes of organizations that are recognized as representing best practices for the purpose of organizational improvement"* (Rankine, 2003 quoting from Spendolini, 1992).
The main objective of the benchmarking technique is to improve any given business process mainly by using best practices. (Bogan & English, 1995) Best practices produce optimum performance in organizing and operating a business. Firms that are studying the best practices have more opportunities to gain strategic, operational and economic advantages (strategic, operational and economic advantage). Additionally, systematic use of the technique aims to identify, study, analysis and adaptation of best practices and to implement best results.
The process of benchmarking is to compare the performance of an enterprise - based on a set of measurable strategic parameters (indicators) - to another business that has achieved the best performance obtaining these specific indicators. The development of the technique of Benchmarking is an iterative and ongoing process that involves the exchange of information with other organizations, so that, together with them, to establish an acceptable system of measurement.

3.2.3.2 The objectives of Benchmarking

The technique requires the collection of information from a company in order for them to be positively assessed. The aim of the technique is to improve the processes that the business is running, through the implementation of effective procedures (human resources, equipment and information systems) (Bendell et al., 1999). It is a valuable operational technique, which is not limited to the sole identification of innovative procedures, applied by a company, but also includes the discovery of the ideas behind the innovative processes of other companies in the field.

Figure 3.4: The Benchmarking Process



Source: Cuadrado et al., (2004)

The formulation of certain common areas that will form the basis for comparison is also necessary for the operation of the technique. Usually one or more functional areas are identified for analysis and one or more measurement systems are selected, as a quantitative basis for comparison. Each functional area consists of various parameters, quantitative and qualitative criteria. Furthermore, it is possible for the researcher to quantify qualitative criteria, as long as this quantification is commonly used to all businesses. The technique works as long as the criteria can be the result of an agreement or be consistent with economic theory and can find appropriate benchmarks for which there are measurements available for the industries to which it applies.

For example, at the main report on "Port Benchmarking for Assessing Hong Kong's Maritime Services and Associated Costs" (2006) the factors that were analysed in the study were port charges, container throughput (TEUs), characteristics of container terminals and port formalities. The results constituted a landmark for the port's headquarters to change their systems, and in short, were the following: *``Long processing time, inappropriate formalities and unclear rules/regulations which become serious obstacles to visiting ships'* Marine Department, (2006).

In the case of Danish port's efficiency, the researchers observed that one element of the quantitative benchmarking may include a quest to find out about the similarity of

the ports' "external efficiency" in what concerns the ports' market growth and the ports' effectiveness, in relation to time and price. This factor was used to assess if there is a potential for increasing the efficiency of ports, through a greater distribution of "best practice". Furthermore, an analysis of the relation between the ports' competence and market position has been conducted, as well as a comparison of the ports "internal efficiency" has been completed covering aspects such as financial position and capacity exploitation. (PLS Consult et al., 1996)

3.2.3.3 Types of Benchmarking

In general, there are four types of benchmarking:

a. Benchmarking the competitors
Benchmarking is carried out for many reasons: to analyse competitors and their data, to measure criteria for competitors' success, to investigate and examine the reasons why the competitors have higher performance than our company (Gal-Or and Esther, 1997). This type of benchmarking is a very complicated procedure, even though it does not seem like it, at first glance; at the beginning, it examines many exogenous variables that affect business performance, in all companies that belong to the same industry. The difficult part derives from the fact that most of the leading companies never publish their data, so it is extremely difficult to find functional elements to create baselines. However, such difficulties can be overcome if the two firms aim, for example, at different markets. In order for the comparison between competitors to be effective, there should be conducted in relation to the strongest competitor or competitors, which are generally recognized as market leaders.

b. Benchmarking the procedures
It consists of a set of procedures that may be similar among themselves, but are applied to different companies, producing similar products. For instance, the catering service in airlines and the catering service in hospitals, respectively. This application provides the ability to assimilate procedures from other successful and efficient companies in other sectors.

c. Internal benchmarking
This process applies to companies that have many branches, such as multinational companies, or companies with sales offices throughout the country, or companies with many plants within the same country.

d. Generalized benchmarking
In this case, the researchers examine the technological aspects of the implementation and development of technology as the main contributors, in order to maximizing the efficiency of a firm.

3.2.3.4 Advantages and benefits of this technique

According to MacIntyre (2005), the importance of benchmarking comes from the four steps of: "learning by example, adopting best practice, sharing information and making performance step changes". In the same article, Geoff Adam, head of marketing for the Port of London, mentions that benchmarking ports is actually 'a

question of learning from others'. Frequent assessment and evaluation of performance allows the detection of gaps in performance, and also the chance to observe where performance can be expanded. By examining and observing these performance improvements, we will witness how many additional benefits we have gathered. Checking the bigger picture provides us a wake-up call and presents means to accomplish a step-by-step transformation in operations. It allows the researcher to find new ways of operating, as well as, it assists the company in developing its staff skills.

Also, according to Harrington and Harrington (1996), the technique of Benchmarking offers the following advantages and benefits to businesses and organisations:

- It pinpoints the areas of practice and performance that a company is lagging behind and which require attention and improvement.
- It records the actual position of the company (using several criteria) against the other competitors, thus facilitating this company to strengthen its organizational efforts to change and develop action plans.
- It measures the current performance of each company.
- It identifies the strengths and weaknesses of each company participating in the industry.
- Prevents the "reinvention of the wheel": there is no reason to invest time and money on something that has already been implemented by some other company and even more often, better, cheaper and faster.
- It speeds up process of change and restructuring:
    - Using proven and best practices from industry leaders.
    - Persuading key employees who question the effectiveness of implementing proposed change, to discover that these changes will bring impressive results.
    - By creating a sense of urgency for action for all employees, when they are shown measurable weaknesses and failures.
- Forces organizations and businesses to review existing procedures, which leads to improvements both within the organization, as well as throughout all managerial procedures.
- Leads to evacuation and encourages new ideas, finding and identifying ways to improve the business.
- Makes it possible to identify other companies and / or organizations implementing processes that have lead to higher performance and then it promotes the adoption and the integration of these processes in the business.
- Leads to the enhancement of functional chances, since it involves all the factors in any process.

The process of Benchmarking in principle is nowadays applied at a company or organization, but is also applicable to many other areas, such as all firms in an industry or even in international organizations. The technique of Benchmarking includes the knowledge, information exchange, comparison and adoption of best practices, in order to draw the best and most useful conclusions with regard to performance. (Boxwell, 1999)

Benchmarking an enterprise or organization is recognized today as a key tool for improving efficiency, making changes and improvements in processes and in each case, it provides a framework for learning from others who have succeeded in their field.

According to Rankine (2003), when benchmarking is used for the appraisal of throughput productivity within a terminal, operators are inclined to check for

problems such as vessel measurements (number of lifts per crane operating hour, average delay per vessel departure, number of lifts per vessel hour, number of lifts per quay labourer hour), yard measurements (average truck cycle time, number of lifts per 'yard crane' operating hour, net container lifts per gross container lifts, TEUs stored per hectare of terminal, mean storage dwell time, mean stack height), gate measurements (entry gate delay per arriving truck, exit gate delay per departing truck, trucks per gate per operating hour,) and equipment measurements (equipment availability, mean time between failures, mean time to repair per failure).

3.2.3.5 Applications of Benchmarking in the transportation sector

Although the use and development of Benchmarking in firms has a large scope, in the domain of transport, especially in ports, benchmarking has a delayed and limited implementation. The main applications that have occurred in recent years are:

(a) PLS Consult (1996) examined the ports of Copenhagen, Århus, and Aalborg in order to analyse the factors that determined the usage of the ports attractiveness and efficiency. Their analyses lead to an assessment of the possibilities for increasing the ports' efficiency and concluded in recommendations for achieving this.
(b) Friedrichsen (1999), presented the results of a study carried out using Benchmarking techniques, aiming to analyse the factors that explain the use of ports and their effectiveness. The effectiveness was divided into two parts, the external indicated in terms of time and money, in relation to port users and the internal covering aspects such as the economic status of ports, etc.
(c) Benchmarking implementation was carried out by Deiss (1999), in order to identify and capture improvement of the transport sector, analysing the causes of variations in road and rail.
(d) Baerlund (2000), studied the application of Benchmarking in transportation as a whole. He identified the relationship between transport policy formulation process and placement of objectives, such as how to implement transport policy in order for it to be effectively managed. With the technique of Benchmarking he measured this relationship in the whole of European Union, focusing particularly in France.
(e) Fearnley et al. (2002), studied the use of Benchmarking as a tool for the quality, effectiveness and efficiency in transportation systems in both the public and the private sector. They presented an innovative application of Benchmarking in transport policy and transport systems.
(f) Lima and Herz (2003), described the operating procedures of a large international organization (in their field study they scrutinized the Maricopa County Department Transportation (MCDOT), Arizona, USA) and analysed how the use of Benchmarking is capable of creating a method of collection, identification and analysis that can measure the effective functioning of any managerial body.
(g) Mulley and Nelson (2003), used Benchmarking techniques in order to measure the degree of success in the management of public bus-use in England. Using the economic theory they specified the possible causes of failure and Benchmarking measured what should be implemented in order to achieve the maximum degree of effective operation of buses. Additionally, they studied the difference between public and private buses.

(h) Rankine (2003) examined the benchmarking container terminal performance in Rotterdam and concluded several interesting things, categorizing his findings as it follows: every terminal is diverse with its own limitations, whether those limitations have to do with size, shape, navigation or linkage with the hinterland. The aforementioned factors influence: charges, level of service and productivity of labour and capital.
(i) Isoraite (2004), studied the use of Benchmarking as a management tool for those engaged in transport policy in order to formulate strategies to reduce the levels of public expenditure in Lithuania and to improve the support of the transport sector.
(j) Michalopoulos (2006) in his PhD thesis first introduced a model which measures the competitive position of the Piraeus container handling port in the Mediterranean region. This author used many indicators (such as demand, supply and labour variables) in order to classify the competitive position of each port. Furthermore, he compares the position of the Piraeus port with that of the leader port and concludes offering significant remarks why the port of Piraeus lags from the leader port in the defined market.
(k) Pardali and Michalopoulos (2008), based on the aforementioned PhD thesis measured the competitive position of the same port in the same specific market. They mention that this model could be implemented in every port of a defined market. In the next section we will describe the main characteristics of this methodology.

3.2.3.6 The adoption of the Benchmarking for the measurement of port competition

By its very definition, Benchmarking aims to provide a powerful and lasting way to measure the performance of a company against the best in the market (Bendell et al., 1998). Additionally, Benchmarking technique refers to those factors affecting the attractiveness of a region, a district, or a country as a place of business. The attractiveness of a place affects the business environment in which firms are required to operate.

According to Karlof (1999), the benchmarking competitive conditions, allow analysis of specific areas of the environment, in which a particular businesses operates, and also allows comparison of a business to existing best practices in other geographic areas.

The area of global port industry consists from enterprises (ports) operating in specific geographical areas. For instance, the ports of Rotterdam and Amsterdam operate in the Hamburg-Le Havre range while the ports of Gioia Tauro and Marsaxlokk operate in the Mediterranean area. So, every geographical area is considered to be a separate market. Within the same market (region), the ports compete with an aim to increase their market share as much as possible.
Given the world-wide economic crisis, which introduced additional pressure on costs and efficiency of land utilisation, benchmarking is a functional tool that can be applied for any container terminal (or port), in order, not only to identify and overcome bottlenecks in the current operations, but also to be used efficiently during the planning stage for the purposes of preventing delays for the period of expansion and improvement of the terminal (or port in general). On the other hand,

benchmarking can be also utilised on the qualitative level in order to facilitate the identification of both existent and probable weaknesses of the terminal. According to Rankine (2003) "*when one bottleneck to the smooth flow of containers is removed, the opportunity is created for another bottleneck to crop up. An efficient terminal has to be well balanced with compatible capacity throughout all the diverse operations within the terminal*". After all, the customer will consider the overall functions and environment of a port rather than that of one terminal only.

With the use of the Benchmarking technique it is realistic to say that we can estimate many of the components that determine the environment of a port, if we have the necessary information for this measurement (Cuadrado et al., 2004).
All these findings define the basis on which a new methodology created using the benchmarking technique for measuring the port competition in a defined market is established. This methodology is based on the following characteristics (Michalopoulos, 2006):

1. It takes under consideration many variations currently existing at the global port industry area.
2. It is capable of measuring the competition by using more than one variable.
3. Uses both quantitative and qualitative variables.
4. It is a flexible methodology, which means that in the same model variables can be inserted or excluded (e.g. due to lack of information).
5. The calculation takes into account the elements of demand, supply and quality of service.
6. It can be applied to any number of ports.
7. By creating the benchmarking score (BestSCORE), which is the standard (per variable and all variables) on all ports, it enables port or terminal operators to set goals and guide strategic port planning in such a way as to become leaders in the market.

Concluding our analysis, we should note that other methodologies that have been implemented for the measurement of port competition do not have the aforementioned characteristics (Michalopoulos, 2006).

Chapter 4: The Demand and Supply of the eastern and central Mediterranean port industry

4.1 Introduction

The scope of this chapter is to pave the way for the rest of our analysis. In order to achieve this aim, first we will define the special geographical area in which we will focus and then we will select the ports of our examination based on their cargo volume. Following, we will study the demand of the examined ports attempting to create a general understanding about the cargo volumes of each port using data from 2003-2009. Also, based on the literature, we will examine the nature of the demand (getaway or transshipment) for those harbors. Considering the supply side of the E. & C. Mediterranean port industry, we will focus on a few important elements, which influence the level and the quality of provided services by a container terminal. More specifically, we will examine the number of container terminals as well as the terminal operators in the selected area. Finally, we will see what kind of equipment each port has in terms of quay cranes, yard cranes & vehicles. Apart from the aforementioned scope, another aim of this assessment is to observe the trends and the likely differentiation of each one of those ports (e.g. many of those ports are having high correlation with the global terminal operators).

4.2 Selection of the container handling ports in the eastern and central Mediterranean region

The Mediterranean region is a very crucial area for both economic and historical reasons. Due to the connectivity of this area with the Atlantic Ocean, the Red and the Black Sea, a remarkable trade history has been developed from the ancient times. The Mediterranean Sea is the natural border of more than fifteen countries from the European, the Asian and the African continent. In other words, the Mediterranean Sea connects three different continents and includes the Suez-Gibraltar shipping route, which influences decisively the trade development. During the last decades, the trade has been rapidly containerized and for that reason, ports have tried to benefit as much as possible from this new trend. Due to that reason, the Mediterranean ports have put a strong emphasis in developing their container terminals. In our research, we are trying to identify how these terminals have been upgraded during those years. However, we will not analyze all the Mediterranean area but only the east and central region[10]. The reason behind this decision was that we believe that the main competitors of the Piraeus port exist in its closer geographical area. These competitors deal not only with import-export market but also with transshipment activities. Even in the case of the transshipment market, the eastern Mediterranean ports are not intensively competing the western Mediterranean ports (Cullinane and Khanna 2000). Our opinion is strengthened by

[10] In that sense, the Mediterranean Sea in our analysis will include also the Aegean and Ionian Sea.

the fact that Pr. Karlis also share the same point of view[11]. Pr. Karlis is the head of the strategic design department of Piraeous Port Authority. For these reasons we will study the eastern and central meditreranean region and not the western mediterranean region. So in the table below (table. 4.1) we can observe how the ports of this defined area are distributed.

Table 4.1: Distribution of the E. & C. Mediterranean container ports according to CIY 2009

EUROPE			ASIA / AFRICA		
COUNTRY	**PORT**	**CARGO VOLUME (2007)**	**COUNTRY**	**PORT**	**CARGO VOLUME (2007)**
ITALY	BRINDISI	5,369	TURKEY	ANTALYA	63,399
ITALY	CATANIA	22,504	TURKEY	IZMIR	892,217
ITALY	GIOIA TAURO	3,445,337	TURKEY	MERSIN	782,028
ITALY	NAPLES	460,812	TURKEY	ISKENDERUN	-
ITALY	PALERMO	31,767	TURKEY	ANTALYA	-
ITALY	TARANTO	755,934	CYPRUS	LIMASSOL	377,037
MONTEN.	BAR	-	CYPRUS	LARNACA	-
MALTA	MARSAXLOKK	1,901,180	ISRAEL	ASHDOD	808,2000
MALTA	VALLETTA	55,729	ISRAEL	HAIFA	1,148,628
SLOVENIA	KOPER	305,648	LEBANON	BEIRUT	947,625
CROATIA	RIJEKA	145,041	SYRIA	LATTAKIA	533,006
GREECE	ASTAKOS	-	SYRIA	TARTOUS	5,525
GREECE	HERAKLION	-	EGYPT	ALEXANDRIA	471,334
GREECE	PATRA	-	EGYPT	DAMIETTA	978,193
GREECE	PIRAEUS	1,373,138	EGYPT	EL DEKHEILA	453,181
GREECE	THESSALONIKI	447,211	EGYPT	PORT SAID	3,011,000
"-" = No availability of data for the year 2007 from CIY or port authorities or terminal operators sites			LIBYA	BENGHAZI	62,891
			TUNISIA	RADES	383,176
			LIBYA	TRIPOLI	59,232

source: Containerisation International Yearbook (2009-2010)

From the above table we can observe two crucial factors for our research.

- At first, we shall not take under consideration the western part of the Mediterranean. More specifically: Spain, France, Morocco, Algeria and the western part of Italy (port of Savona, Genova, La Spezia, Marina Di Carrara, Leghorn, Naples, Salerno & port of Palermo), are not included in our research due to the geographical elimination that we have done.
- Secondly, ports in the Marama Sea (which connect the Mediterranean Sea with the Black Sea) are also not included in our research, since they are mainly serving countries of this specific area and the Black Sea. Moreover,

[11] We obtained this information after a personal interview held in his office.

these ports are out of the specific geographical area we want to study. Due to the above reasons, harbors like the port of Gemlik, Borusan, Istanbul, Burgas and Constanza are out of our scope, even though we acknowledge that some of these ports (like Istanbul and Constanza) are very important.

Additionally, many of the ports presented in table 4.1 are not very competitive (in terms of cargo volume) and so we have to further eliminate them, based on their annual TEU throughput. In order to achieve this elimination, we decided to choose the ports that are included in the 170 biggest container handling ports (table 4.2).

Table 4.2 Port Traffic League 2007-2008 (TOP 170)

RANK[12]	**NAME OF PORT**	**COUNTRY**	**CARGO VOLUME 2007 (TEU)**	**CARGO VOLUME 2008 (TEU)**	**AVERAGE CARGO VOLUME (TEU)**
1	GIOIA TAURO	ITALY	3,445,337	3,467,272	3,456,305
2	PORT SAID	EGYPT	2,820,000	3,202,000	3,011,000
3	MARSAXLOKK	MALTA	1,901,180	2,334,182	2,117,681
4	HAIFA	ISRAEL	1,148,628	1,262,000	1,205,314
5	DAMIETTA	EGYPT	978,193	1,142,184	1,060,189
6	PIRAEUS	GREECE	1,373,138	433,582	903,360
7	IZMIR	TURKEY	892,217	895,000	893,608
8	MERSIN[13]	TURKEY	782,028	854,500	818,264
9	ASHDOD	ISRAEL	808,200	827,900	818,050
10	TARANTO	ITALY	755,934	786,655	771,294
11	LATTAKIA[13]	SYRIA	533,000	570,000	551,500
12	ALEXANDRIA[13]	EGYPT	471,334	548,124	509,729

source: Containerization International Yearbook (2009-2010) & Piraeus port authority

From the table 4.2 we can observe that Egypt has three ports, while Italy, Turkey, and Israel have two container handling ports. Only Malta, Syria and Greece have one container port. However, we would like to comment that this fact alone cannot be perceived as an indication of the competitive position of the countries. Later (in chapter 5) we will analyze the competitive position of each port, but, for the time being, it is too early to jump to any conclusions. Generally speaking, the selected ports have had some variations during the years, but we can see that they still remain at the top container handling ports rankings, in the eastern and central Mediterranean Sea. Taking under consideration the interview that we had with Prof. A. Karli, the above ports are, in fact, the main competitors of the Piraeus container

[12] The counting concerns the average cargo volume of the years 2007-2008.
[13] For these specific ports, we were not able to collect all necessary data and for that reason, we have not included them in our analysis.

terminal, along with the ports of Constanza and Istanbul which are not included in our analysis, because they are not geographically located in the Mediterranean Sea.

Figure 4.1: Top E. & C. Mediterranean container ports

Source: Foschi (2003), 'The maritime container transport structure in the Mediteranean and Italy'

4.3 Demand Analysis of the eastern and central Mediterranean port industry

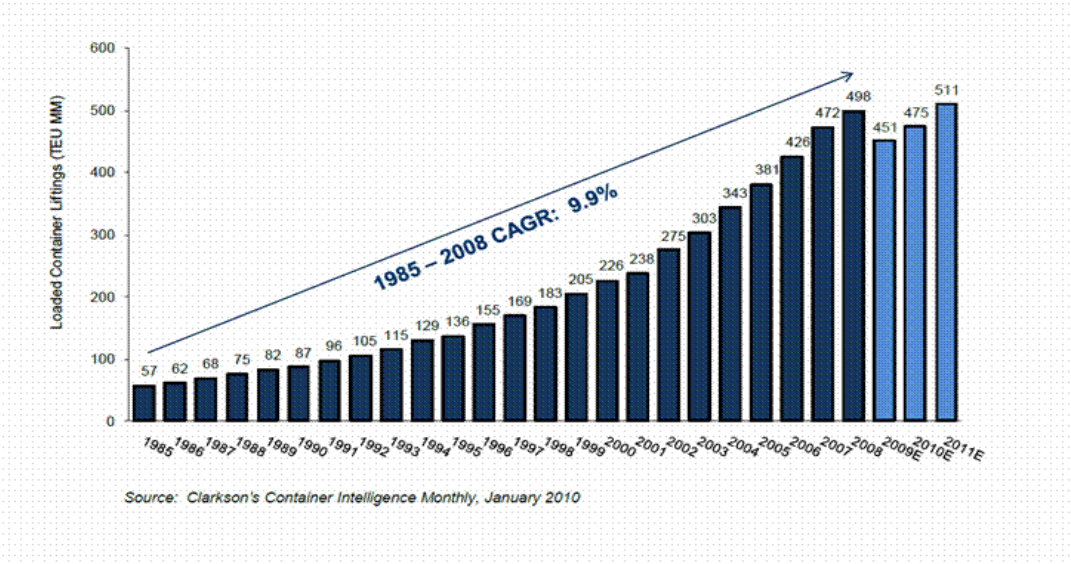
Demand examination is divided in two parts; at the beginning of the first part, we will briefly analyze the historical reasons behind the development of the global container throughput and the global growth rates of the ports. Later, we will focus on the core of our assessment, which is the demand for the E. and C. Mediterranean region using data from 2003-2009. In the second part of our analysis, we will identify the nature of this demand (transshipment or getaway) for the selected ports. However, because it was impossible to collect all necessary data for transshipment volumes (due to the fact that almost all the operators prefer not to reveal them) our research is based on the existing literature.

4.3.1 The identification of demand based on the total container volumes (TEU's)

During the last decades, the handling container ports have started developing steadily, but rapidly. According to some researchers (Gunther & Kim, 2006; Pardali, 2007; Chlomudis, 2001), the main reasons behind this development of container traffic can be summarized in the following factors: Since the beginning of the 1960's, the regular sea container services started to develop quickly, especially between ports of the US East Coast and those of the South and Central America. During the next decades the trade routes between other areas developed as well, and the outcome became that nowadays, some major sea freight routs have been one hundred percent containerized. Another crucial fact was that the total transportation capacity of the containerships had been rapidly increasing. This capacity had strongly shifted, not only because more ships had been built, but mainly because the size of those ships had multiplied during the last decades. In other words, the economies of scale increased the size of the ships while at the same time, reduced the transportation cost per TEU. This decrease was achieved due to the proportional reduction of fuel cost, the labor cost and shipbuilding cost. These three types of costs, strongly reduced, the total transportation cost and made more attractive and efficient the transportation of goods by containers. For that reason, commodities, which traditionally were transferred in bulk ships had started slowly but intensively to be containerized and that fact was very beneficial for both the development of containerships and the container terminals. Nevertheless, in our point of view, the most important element, which influenced the deployment of this industry, was the growth of the global economy. Stronger economy led to higher growth rates at the global trade and this directly influenced the demand for transportation services. In other words, the derived demand for transportation services is directly affected by the global economic environment. Considering the economic growth, this is most broadly measured with the Gross Domestic Product (GDP[14]). So, especially in countries with high increase in terms of GDP (e.g. China), we have also observed a high increase in terms of demand for transportation services. Due the aforementioned reasons, the demand for transportation services and for cargo handling services (from the ports) skyrocketed. The outcome of this development can be easily observed in the (figure 4.2). In this figure, the container handling services had, in average, an annual growth rate of 9.9% for the years 1085-2008. Nevertheless, due to the derived nature of the demand for transportation services, we can observe that mainly from 2008, the demand for container handling services has started to decrease. This growth rate presented a negative slope in the year 2009, while until the present year (2010) the shipping industry is still trying to survive and hopes to return to its previous growth rates.

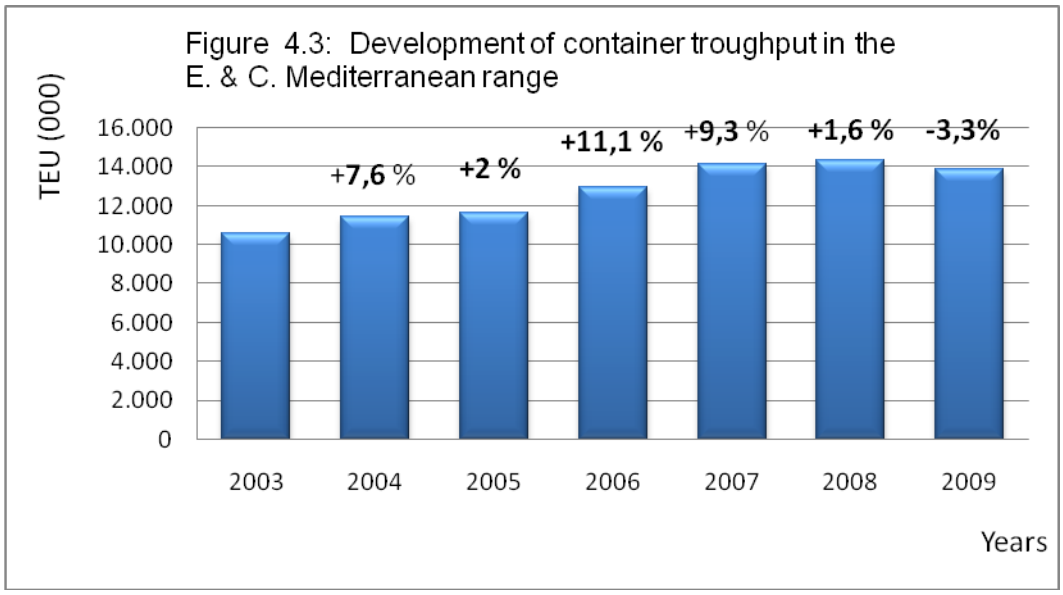
[14]GDP is a very common measurement, which shows the total (official) economic output of a country. More specifically, it measures the market value of all the services and final commodities which were made within the country's borders within a year.

Figure 4.2: Development of global container port throughput



Considering the eastern and central Mediterranean region, our research focus on the collection and interpretation of data from the years 2003-2009. So, the following analysis and examination is based on those seven years.

As we can see from the figure below (figure 4.3), the development of the container throughput in the east and central Mediterranean ports was quite remarkable for the years 2003-2008. The best years, in terms of percentage increase of the cargo volume, was in the years 2003-2004 (+7.6%), 2005-2006 (11.1%) and 2006-2007 (9.3%).

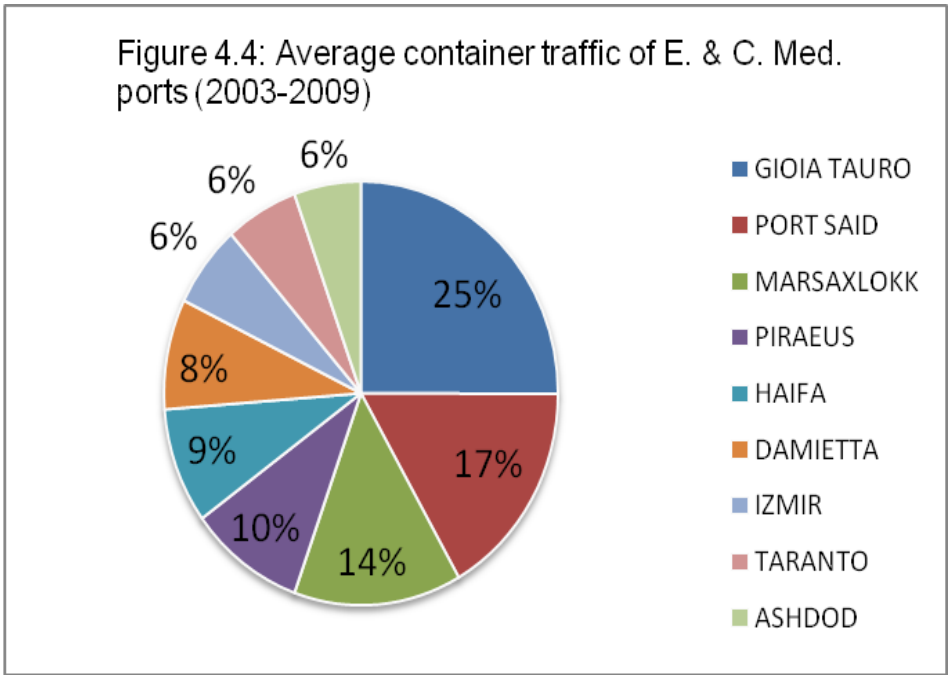


Source: Containerization International Yearbook (2009-2010) & Piraeus port authority

Yet, this growth rate is not so high if we compare it with the evolution of the global cargo throughput. More specifically, for the same period (2003-2008), the average growth rate of the eastern and central Mediterranean ports was 7.4%, while the global average growth rate was 10.5 % (author's calculation). Moreover, the growth rates of the studied container ports (in comparison with the global ports), was at lower levels in every single year and only in the year 2005-2006 the percentage increase was almost the same (11.1 % & 11.8%) but still lower. Only during period 2008-2009 the eastern and central Mediterranean ports presented a "better" outcome (-3.3% growth rate) in comparison with the global growth rate (-9.4%). These facts show as, that at least for the previous year, the ports that interest us had coped better within the economic crisis which deeply hit the port industry.

To sum up, the ports in the east and central Mediterranean Sea have been increasing their container throughput with a lower rate in comparison with the global market for the years 2003-2008. Only for the last year (2008-2009) the situation reversed, but this does not prove necessarily that those ports will have (in the future) less negative effects from the crises that the rest of the global ports.

At this point, we have to make clear that the demand for port (container) services is not the same for every port that we examine. We can observe this logical fact from the figure 4.4.



Source: Containerization International Yearbook (2009-2010) & Piraeus port authority

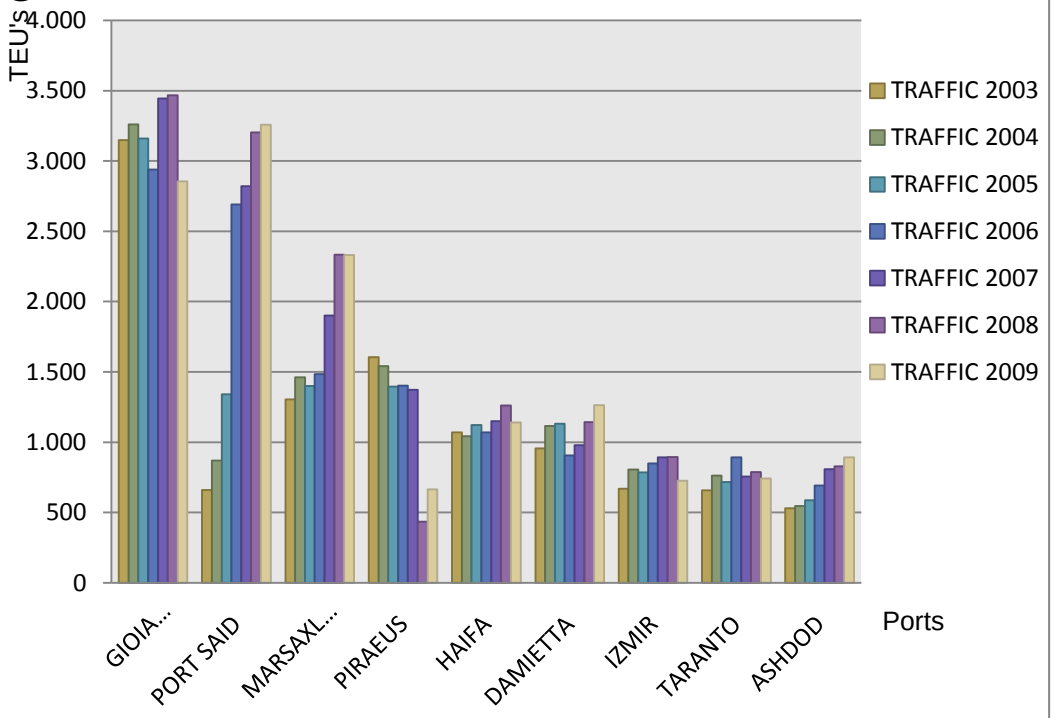
In this figure, we can see that the Gioia Tauro is the first port with a 25% of the total container traffic in the range, while the Port Said ranks second (17%) and the Malta Freeport ranks third (14%). The Piraeus port ranks fourth with 10% and the next two ports (Haifa 9% and Damietta 8%) have very small distance to cover port Piraeus.

Concerning the aforementioned three last ports (Izmir, Taranto & Ashdod), we can say that if we sum up their percentages, they make up a rather small percentage (18%).

Of course, this is only a fist attempt for the recognition of the competitive position of our ports (based on the traffic volume). In the next chapter, we will use the analysis of variance in order to estimate the throughput element in a more scientific way.

Nevertheless, we consider it of major importance to chronologically examine every single port for the years 2003-2009. In figure 4.5 it becomes crystal how the demand for every port had developed during the previous years.

Figure 4.5: The container throughput of the E. & C. Med. ports for the years (2003-2009)



Source: Containerization International Yearbook (2009-2010) & Piraeus port authority

Starting with the Gioia Tauro port, we can observe some small variations, which it presented during this period. More specifically, the container throughput varies from 3,467,000 TEU's (2008) up to 2,855,000 TEU's (2009). Especially, in the years 2007 and 2008 we notice a remarkable percentage increase (17%) of the container throughput. No other port in our examination ever got close to that number. However, on the other hand, during the major economic crisis (2008-2009) the same port had an 18% decrease (see Appendix A) of the container traffic. This is the first year, in which, the Gioia Tauro ranks second in our classification.

In the Port Said case, we can note a rapid increase in terms of demand during the previous years. In fact it is the only port (of our examination) which had such a rapid increase from 2003 until 2009. From the 659,000 TEU's (in 2003) it climbed to 3,258,000 TEU's in 2009. Moreover, between 2005 and 2006 the Port Said had the highest percentage increase (101%) in comparison with any other port in any year. Additionally, we have to mention, that this is the only port which presented positive and steady increase in the cargo volume for every year of our examination. Even in the year 2008-2009, it did not decrease its volumes but it climbed in the first position in the E. and C. Mediterranean region.

In what concerns the Marsaxlokk port, we can easily observe a respectable increase in terms of demand during the previous years. In fact, most of the years it was presenting positive results. Only between 2004 and 2005 the throughput decreased by 4%. Finally, the year 2008-2009, during the crisis, the port did not have any negative or positive influence, but, nevertheless, managed to hold its throughput (0% increase).

The forth port of our analysis is the Piraeus port. It is the only port, which decreased its throughput so rapidly during the years 2003-2009. The worst result was between the years 2007 and 2008 when it presented a decreased of 68% (from 1,373,000 TEU's to 434,000 TEU's). The main reason for this outcome was the repeated strikes, which deeply affected the harbor. The "best" result, in terms of percentage increase, occurred during last year (2008-2009). The container throughput increased by 53% (from 434,000 TEU's to 665,000 TEU). In reality, that increase is totally justified due to the fact that it is logical to compensate the decrease (of the year 2007-2008) presenting an increase in the following year. However, in order to have a better understanding of the volumes and the reasons, which influenced the competitiveness of the specific port, we will make a more thorough analysis in the chapter for the Piraeus port.

The fifth harbor in our study is the Haifa container port, which had the most stable cargo volumes in comparison with the other ports. More precisely, it varied from 1,043,000 TEU's (2004) to 1,262,000 TEU's (2008); and it presented the lowest percentage changes examining throughout the years.

In what concerns the Damietta port, we can notice that, in many of the years, the container throughput increases. Even in the year 2009, the cargo volume portrayed a respectable percentage increase of 11%. Only for the year 2005-2006 the port had a decrease (20%) in its volumes.

Examining the Izmir port, the demand had never surpassed the 900,000 TEU's. So, in a general point of view, it does not have a significant high container throughput at least for the years under examination. Only, for the year 2009, the port of Izmir had the highest percentage decrease (19%) in comparison with the other ports in the east and central Mediterranean Sea. This fact shows us that it was deeply hurt by the current crisis.

The Taranto harbor is also a port with low volume of container cargo. A very remarkable note in our examination is the fact that in every consecutive year, the growth rate fluctuates between negative and positive results. The best year in terms of container throughput was the period 2005-2006 with 892,000 TEU's

The last port of our examination is the Ashdod harbor. In this case, we can see a slight but stable increase of demand year by year. The aforementioned port together with the Port Said, are the only ports with growth in the demand (each year). Finally,

the lower increase, in terms of throughput volumes, was in 2008 (2%) while the highest increase was in 2006 (18%).

Concluding this part of our analysis, we have to mention that the container throughput volumes is the main indication for the determination of the demand in a port. All the above analysis includes containers, which were intended for import/export and-or transshipment proposes; the empty containers were also included in that throughput. Nevertheless, many researchers (Notteboom, 2010; Yeo et al.,2008; Yap et al., 2005; Cullinane et al., 2005; Yap and Lam, 2005; Foschi, 2003) have examined the demand of various ports taking under consideration only the total throughput in TEU's[15] and for that reason, we are estimating the demand based only in the total cargo volume. A more in depth analysis is needed, but since for us it was rendered impossible to collect all necessary data, we focused on the most traditional approach of the total cargo volume. We will use the same methodological approach in the next chapter, when we will try to recognize and determine the competitiveness of the terminals using the analysis of variance and the benchmarking technique. However, we have to make point out, that since the transshipment containers are counted twice in the statistics of the ports (Acciaro, 2006; Fegeda, 2000); the results produced cannot be one hundred percent accurate. Judging from the literature and from very distinguished authors who knew about the aforementioned fact but still proceeded with a similar research approach, we too consider the data collected accurate enough to use in our calculations and come up with truthful results.

4.3.2 Nature of demand (transshipment or getaway) for the selected ports

Scope of this part of our analysis is to identify whether the shipping lines prefer the ports under examination for a local or a transshipment distribution of the containers. Unfortunately, it was impossible to collect the necessary data for every port and especially for the transshipment ports, due to the secrecy of operators on the specific subject[16].So we have chosen a more general approach on the subject and we focus only on the Piraeus case, which is the core of our study.

We can classify the container ports into two categories: the transshipment ports and the getaway ports (Acciaro, 2006 Fageda, 2000). Both of these kinds of ports are having many common characteristics in terms of infrastructure and superstructure. However, they operate from different perspectives and with an eye to satisfy different transportation needs. In order to have a better understanding we will give a brief explanation for both types of ports.

Getaway ports: These ports are traditionally located close to important metropolitan areas with a significant volume of exports and/or imports. In order for such cargoes to be transferred the port must fulfill a crucial prerequisite, which is that this port is connected with an efficient intermodal transportation (rail, road & barges) network.

[15] Without separate the analysis in the empty, import/export or transshipment containers.

[16] As for example, the Marsaxlokk denied sharing any transshipment information due to their confidentiality policy. The same happened also and with other ports like the Taranto, Damietta and Haifa ports.

By the help of this network, the megacarriers are able to transfer, with direct calls, the necessarily containers from the deep sea to the crucial consumption areas (Schinas & Papadimitriou, 2002). Exactly the opposite procedure takes place when a production area provides containers (most of the times, final goods) from the land to the sea leg. Finally, we should mention that most of the times, the getaway ports are providing added value services not only because they want to satisfy customers needs, but also because it is a very important source of income revenue (Athanasopoulou, 2006).

Transshipment-hub ports: The most important function for a hub port is the ship-to-ship transportation of containers. In this case, a mother ship approaches the transshipment port and unloads the containers, which are stored for a short (most of the times) period. Later, a smaller (feeder) ship will load those containers and will transport the cargo into smaller (spoke) ports in the same geographical area (Foschi, 2003). In this way, the mother ships are eliminating the voyage time as well as the number of calls, while, at the same time, the feeder ships supply the smaller ports offering high flexibility and speed (Athanasopoulou, 2006 & Pardali, 2006).

Considering the Mediterranean transshipment market, we have to add that the very large ships have inevitably reduced the number of calls into one or two in the Mediterranean Sea (Cullinane and Khanna 2000). If they make one call it would most probably be in the central Mediterranean Sea (such as Marsaxlokk or Gioia Tauro). If, however, they make two calls, then these will most probably be in the western and the eastern ends of the Mediterranean region, such as the Algeciras and Port Said harbors. (Acciaro, 2006 & Schinas 2002). The reason for these choices is the fact that those ports have the smallest distance from the Suez-Gibraltar shipping route.

Considering the identification of the nature of the demand of the ports under examination, some researchers have focused their study, directly or indirectly, on the same matter. Those writers share more or less, the same point of view for the ports under observation. So, we will analyze those publications and later we will conclude with our own point of view with respect to this subject.

At first, Acciaro (2006) in his article: '*The future role of Mediterranean ports in the European logistics supply chains*' mentioned some important transshipment ports, which have a leading position due to their geographical location. Those are the: Damietta, Port Said, Marsaxlokk, Piraeus[17], Gioia Tauro and Taranto[18] ports. The transshipment volumes for those ports and for the year 2003 are presented in the table below.

[17-18] : Those ports require longer deviation from Suez-Gibraltar route and so their transit time increases. Something negatively as consider this route.

Table: 4.3 Major transshipment ports in the E. & C. Med. Sea

PORT	MARKET SHARE TRANSHIPMENT (2003)
Port Said	45%
Gioia Tauro	96%
Taranto	95%
Damietta	80%
Marsaxlokk	100%
Piraeus	57%

Source: Acciaro (2006)

A second article, which examines the Mediterranean ports in the area of mega carriers, was written by Shinas & Papadimitriou (2002). In this article the authors mention that the Taranto, Damietta, Port Said, Gioia Tauro and Marsaxlokk ports are mainly hub ports, while the Izmir, Ashdod and Haifa ports are more getaway ports with small potential[19] for future shift into crucial hub ports. Concerning the Piraeus port, the authors mention a stable shift from a getaway port into a hub port. However, it was not easy for the writers to clearly identify if the Piraeus port was hub or gateway port, due to the short track record[20].

A third article, which studies the hub and getaway ports in the Mediterranean range, was written by Fageda (2001). In this article he mentions that the Gioia Tauro and Marsaxlokk are hub ports and more precisely are the stars[21] of the eastern and central Mediterranean Sea, while ports while Port Said, Taranto, and Piraeus may become important hub ports in the future, but he does not consider them stars in terms of competitiveness. In what concerns getaway ports, only Izmir is a getaway port with very low possibility to compete against the previous ports in the transshipment market.

Another important research was written by Dr. Vlacho (2007) and focused on the investigation of factors, which influence the competitiveness of the Mediterranean container terminals. In this research, the author clearly mentions that the ports of Gioia Tauro, Marsaxlokk, Port Said, Piraeus and Damietta are mainly transshipment ports while the ports of Ashdod and Haifa, service both the local as well as the transshipment market.

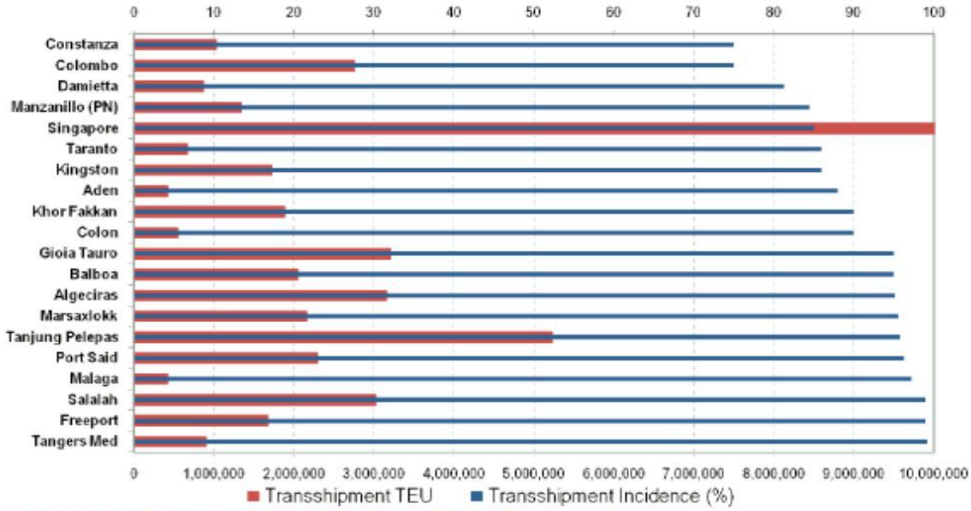
In 2003 Prof. Foschi published an article titled: '*The maritime container transport structure in the Mediterranean and Italy*'. In this research, the writer mentions that the ports of Gioia Tauro, Damietta, Marsaxlokk and Port Said are transshipment ports while the ports Piraeus, Ashdod, Haifa and Izmir are mostly getaway ports. However, the ports of Piraeus, Ashdod, Haifa and Izmir could become important hub ports in the future.

[19] Especially for the port of Izmir.
[20] According to this article, only from 1997 the Piraeus port started handling transshipment containers.
[21] This was a conclusion from the competitive position analysis.

Proffessor Nottebomm (2010), published an article concerning the “Concentration and the formulation of multi-port gateway regions in the European container port system”. In this research, based on data from 1985-2008, he concluded that the ports of Marslaxlokk, Gioia Tauro and Taranto are hub ports with transshipment incidence > 75%. Concerning the Piraeus port, the writer mentions that it is a gateway port, which also handles a substantial percentage of transshipment flows.

Apart from the literature already reviewed, another way to identify if the under examination ports are transshipment or getaway ports is to measure the increase in terms of throughput over a period of years (Shinas & Papadimitriou 2002).

Figure 4.6: Important hub ports in terms of transshipment incidence for the year 2008



Source: adapted from Drewry Shipping Consultants.

The above figure shows the increase in transshipment volumes of some important hub ports for the period 2007-2008. In this figure, we can easily notice that many of these ports belong to the eastern and central Mediterranean Sea. More specifically, the ports of Damietta, Taranto, Gioia Tauro, Marsaxlokk and Port Said are having remarkable increase in terms of transshipment volume.

If we combine data from the abovementioned bibliographical texts and figure 4.6, we can identify the nature of demand for the ports under examination and we can conclude that the ports of Marsaxlokk, Gioia Tauro, Taranto, Damietta and Port Said are the main transshipment ports in the central and eastern Mediterranean region. The port of Izmir is mainly a getaway port, while the ports of Piraeus, Haifa and Ashdod are having important throughput in both transshipment and getaway markets.

In this part of our analysis we will investigate the Piraeus port, taking under consideration all available data. From the table below, we can see that for the years 2001-2009, the ratio for transshipment and for import-export containers is almost the same. More particularly, the average percentage for the transshipment market is forty per cent, while the average percentage for the local (import/export) market is thirty seven per cent (author’s calculations). However, we can easily notice that the

transshipment demand is higher for most of the years and only for the years 2007-2009 this volume decreased rapidly, mainly due to labor strikes in the container terminal of the port. Furthermore, as we will see in chapter 6, the establishment of COSCO Pacific Ltd in the operations of the PCT terminal will change the image of the port from a getaway (& transshipment) port into an important hub with a substantial percentage of getaway flows. Those factors show that the Piraeus port is (at the moment) an important getaway port, with significant increase in terms of transshipment volumes. Most probably in the future it will become an important hub port, which will be also capable to satisfy the demand for import / export transportation of containers.

Table: 4.4: Distribution of cargo traffic in the Piraeus container terminal (2002-2009)

	2001 (000 TEU's)	2002 (000 TEU's)	2003 (000 TEU's)	2004 (000 TEU's)	2005 (000 TEU's)	2006 (000 TEU's)	2007 (000 TEU's)	2008 (000 TEU's)	2009 (000 TEU's)
Import / Export	379	394	419	464	462	443	544	256	378
Transshipment	552	762	909	791	660	694	460	30	83
Empty	234	249	277	287	272	266	369	147	203
Total	**1.165**	**1.405**	**1.605**	**1.542**	**1.394**	**1.403**	**1.373**	**433**	**664**
% of Transshipment	0,47	0,54	0,57	0,51	0,47	0,49	0,34	0,07	0,13
% of Import / Export	0,33	0,28	0,26	0,30	0,33	0,32	0,40	0,59	0,57

Source: Piraeus port authority site

To sum up, the Marsaxlokk, Gioia Tauro, Taranto, Port Said and Damietta ports are mainly transshipment ports, while Piraeus, Haifa and Ashdod ports are having important throughput in both transshipment and getaway market. In what concerns the Izmir port, it is mainly a getaway port. Concluding our analysis, we should repeat the fact that in order to identify the nature of demand for the ports under consideration, we mainly focused on literature review, since all necessary data on most of the ports was not published in any mean available to us (except for Piraeus), so, we did not have any information on transshipment and local volumes. For that reason, we are skeptical about the above conclusion and so, in the following chapter we will analyze the competitiveness of every port without taking under consideration whether the port is a getaway or a transshipment one.

4.4 Supply of the E. & C. Mediterranean port industry

In this section of our thesis, we will study the supply of the Eastern and Central Mediterranean terminals. We will examine some crucial factors, which influence the supply of the port services. More specifically, we will focus on the following factors based on infrastructure and superstructure of every port under examination:

- Number of container terminals and distribution of terminal operators
- Cargo handling equipment
    a. Quay cranes
    b. Yard cranes & vehicles

Of course, the above characteristics are not the only elements, which determine the supply of the ports. According to some authors such as Prof. Pardali (2007) and Dr Michalopoulos (2006), there also exist many other crucial factors, which influence the supply for port (terminal) services in terms of infrastructure and superstructure. Some of them are: the number of berths, the total area of the terminal, the maximum depth, information systems, the storage capacity and the reefer points. All these elements will not be presented in this chapter, because they will be analyzed comparatively in the following chapter. In addition, we would like to present certain other parameters that influence the level of the supply side, such as the price for cargo handling services (Vlachos, 2007; Pardali, 2001). However the availability of such data was extremely limited. So, we will focus only on the first elements with aiming to observe the similarities, the differentiations and the trends for these selected factors.

4.4.1 Number of container terminals and distribution of terminal operations in the ports of the eastern and central Mediterranean region.

Until the beginning of the 1980's the port authorities were responsible to provide port services. During the 1990's however, the status quo changed when the private sector steadily increased its involvement in the operation of the container terminals. As a result, many privatized container terminals were established in the Mediterranean territory. From our study, it became evident that fourteen container terminals exist in the nine ports we examined. From these terminals, the nine (64,28%) operate under the control of private companies[22] while the five (35,72%) operate under the control of the port authorities. From the above result we easily understand that the private involvement has the dominant percentage in the eastern and central Mediterranean container terminals.

[22] We have not included in our analysis the private stevedoring companies.

Table 4.6: The number of container terminals in the E. & C. Mediterranean region

PORT	NUMBER OF CONTAINER TERMINALS	OPERATOR	
		PORT AUTHORITY	PRIVATE COMPANY
GIOIA TAURO	1	0	1
PORT SAID	2[23]	0	2
MARSAXLOKK	2	0	1[24]
PIRAEUS	2[25]	1	1[26]
HAIFA	2	2	0
IZMIR	2	1	1
DAMIETTA	1	0	1
ASHDOD	1	1	0
TARANTO	1	0	1
TOTAL	**14**	**5**	**8[27]**

source: Containerization International Yearbook 2010, terminal operators sites & port authority sites

In what concerns the number of container terminals of the examined ports we are faced with two scenarios. In the first scenario, we have ports with two container terminals: these are Port Said, Marsaxlokk, Piraeus, Haifa and Izmir ports. In the second scenario we have ports with one terminal: these are the ports of Taranto, Ashdod, Damietta and Gioia Tauro (according to CIY). However, this fact does not

[23] According to CIY 20101, the Port Said harbor has one more container terminal (Abbas quay). This is a relatively small container terminal (in terms of throughput and size) which according to the Port Said authority, services not only the containerships but also the other markets (e.g. Ro-Ro vessels). In other words (quoting from the official site of Port Said authority) this area is a multipurpose terminal with very limited specialization in the container field. Furthermore, according to the port authority of Port Said & CIY, it was having a very low throughput during the previous years (<20.000 TEU). Due to the abovementioned reasons, we decided to exclude this terminal from our examination.

[24] One company operates both container terminals.

[25] Concerning the Piraeus case, according to CIY 2010, one more terminal (St, George Terminal) exists in the port, which services Ro-Ro vessels and small containerships. Nevertheless, according to Piraeus Container terminal, the TEU throughput during the last years was so low (<20.000 TEU's) that it rendered the existence of this terminal meaningless, for our analysis. Furthermore, the Piraeus port authority does make some affords in order to transform a part of this terminal into a car terminal. For the aforementioned reasons, we decided to leave this terminal out of our research.

[26] Until September 2009 it was one container terminal (Venizelos Con. Ter.), under the management of Piraeus port authority. From October 1st, 2009 the terminal was separated into two terminals (PCT & PPA) and the smaller part remained in the PPA while the bigger part shifted in a private operator.

[27] Eight private companies control nine container terminals.

mean that the ports with two terminals are necessarily "better" in terms of competitiveness. For example, the Gioia Tauro port has only one terminal but it is a leader port in the Mediterranean Sea. In order to obtain a more scientific approach, it is more appropriate to examine the existence of intra-port competition in those ports. So, considering the intra-port competition amongst private operations, we found that only in Port Said' case, two private companies operate in the same port. Nevertheless, the intra-port competition exists also to some extent, between private and public terminals in the Izmir and Piraeus ports. Considering the cases of Haifa and Marsaxlokk ports, we have to say that no intra-port competition exists from the moment that both of the container terminals are under control of the same port authority or private company. So, from a general point of view, the intra-port competition in the eastern and central Mediterranean region is not as intense as it is in some other regions (Athanasakopoulou, 2006). A clear example is the Hamburg-Le Havre region, which has by far and away, higher level of intra-port competition.

In the following table, we identify and briefly analyze the private companies which operate in the eastern and central Mediterranean region.

Table 4.7: Private companies operating in the container terminals of the E. & C. Mediterranean region

PORTS	COMPANIES	CONTAINER TERMINALS UNDER OPERATION
GIOIA TAURO	MEDCENTER CONTAINER TERMINAL SPA	1
MARSAXLOKK	MALTA FREEPORT TERMINALS LTD	2
TARANTO	TARANTO CONTAINER TERMINAL SPA	1
PIRAEUS	PIRAEUS CONTAINER TERMINAL SA[28]	1
IZMIR	TCE EGE KONTAYNER TERMINAL ISLETMELERI AS	1
DAMIETTA	DAMIETTA CONTAINER & CARGO HANDLING CO	1
PORT SAID	PORT SAID CONTAINER & CARGO HANDLING CO	1
PORT SAID	SUEZ CANAL CONTAINER TERMINAL	1

source: Containerization International Yearbook 2010, terminal operators sites & port authority sites

From the above table, we notice that from the selected harbors, only one private company (Malta Freeport) operates two terminals within the same port. All the other private companies are operating one terminal in those seven ports. However, in order to understand the composition of the companies and the connection with the top global container terminal operations we shall take a deeper view at this point. Before we start with this analysis we find necessary to identify which are the top global container terminal operators.

[28] PCT SA (subsidiary COSCO Pacific limited) started to operate the Piraeus Container Terminal (PCT) on October 1st 2009.

Table 4.8: Top global container terminal operators

rank	name operator	throughput (2004)		capacity (2004)	capacity plan (2010)
		Million TEU	Share (%)	Million TEU	Million TEU
1	HPH	47.8	13.3%	53.9	71.9
2	APMT	34.0	9.5%	43.6	68.7
3	DP World	33.3	9.3%	40.8	59.3
4	PSA	33.1	9.2%	39.4	64.6
5	COSCO	13.3	3.7%	15.7	32.9
6	EUROGATE	11.5	3.2%	14.0	19.4
7	EVERGREEN	8.1	2.3%	9.1	14.1
8	SSA Marine	6.7	1.9%	8.5	9.9
9	MSC	5.7	1.6%	7.1	16.5
10	HHLA	5.6	1.6%	6.9	9.8
11	APL	5.3	1.5%	6.0	6.7
12	HANJIN	4.4	1.2%	5.4	10.9
13	NYK	4.4	1.2%	6.6	6.6
14	OOCL	3.6	1.0%	4.1	6.7
15	MOL	3.6	1.0%	3.8	3.8
16	DRAGODOS	3.1	0.9%	4.5	7.1
17	K LINE	2.6	0.7%	3.3	4.1
18	TCB	2.4	0.7%	4.4	4.5
19	ICTSI	1.9	0.5%	2.9	4.1
20	YANG MING	1.7	0.4%	1.5	2.4
21	HYUNDAI	1.2	0.3%	1.1	5.1
22	CMA CGM	1.2	0.3%	2.1	5.1
Global Operators Total		234.5	65.1%	284.7	434.2

DPW including CSXWT & P&O Ports (including terminal in USA)
APMT including P&ONL
Data: Drewry Shipping Consultants

From a general point of view, we can classify the global container terminal operators into two categories based on their parent companies (Mori, 2009). In the first category, the global container terminal operator has as a parent a stevedoring company or the port operation, while in the second category the global terminal operation has as a parent a liner shipping company. In the second case, we can identify many top liner companies (according to the CIY of 2010), which are the parents for the above global container terminals. For instance, the MSC, CMA-CGM, Evergreen line, COSCO and K-line are some very important shipping lines which have used the vertical integration in order support firstly their core liner business and secondly, to service third parties with an eye to increase their profits (Mori, 2009).

Starting our analysis in the E. & C. Mediterranean range, we have to mention that many important global terminal operations are operating in those ports.

Considering, the Medcenter Container Terminal (MDC) of Gioia Tauro port, we found that it is a joint venture company in which, the majority of shares are held by Eurogate while the minority is held by APM terminals. According to Prof. Notteboom (2007) the Eurogate has the 67% of the shares while the APMT has the 23%.

Nevertheless, from the more updated site of APMT we find that this company holds nowadays a 33% of the shares. This is an outcome of the acquisition that took place in 2005 (according to Mori, 2009). Nevertheless, the same author supports that despite this change, the majority of shares continues to remain in the Eurogate Company. Concerning the Eurogate Company, we could not find any updated data from the official site or any other source.

In the Marsaxlokk port case, the Malta Freeport Terminals are operated by the CMA CGM company. According to the official site of the terminal, from October of 2004, CMA CGM is operating the container terminal after the concession agreement with the government of Malta. In fact, the satisfaction of these two parties is so apparent that in February of 2008 the government of Malta provided in CMA CGM an extension of the concession agreement, turning the original 30 year period into 65 years in total.

According to the official sites of Evergreen company and port authority of this harbor, the Taranto Container Terminal (TCT) was founded in 2001 and is part of the Evergreen Marine Corporation. However, taking under consideration the most recently updated site of Bloomberg and the official site of the Hutchison Port Holdings (HPH) operator, we are informed that from December 2008, the TCT Company operates as a subsidiary of Evergreen Marine Corporation and HPH Corporation.

Concerning the case of Piraeus, the COSCO (China Ocean Shipping Company) made a concession agreement with the government of Greece in order to operate the Piers 2 & 3 at the Venizelos container terminal. With respect to Pier 1: it remained in Piraeus port authority. In that way, the Piers 2 & 3[29] became the Piraeus Container Terminal (PCT) while the Pier 1 became the Piraeus Port Authority (PPA) container terminal. The COSCO Pacific operates the terminal from October 1st 2009 and the concession is for 35 years (30 years with 5 year extension possibility). According to the official site of COSCO and the CEO of this company the PCT is the first 100% owned overseas container terminal that is operated by the aforementioned company and that fact has a unique importance for the COSCO Group.

For the Izmir private terminal, the TCE Ege Konteyner Terminal Isletmeleri operator is subsidiary company of the Spanish TCE group. At this point, we have to mention that from our research, we found two sites which mention that the Hutchison Port Holding (HPH) won the concession for the port of Izmir in 2007. However, according to the official site of Hutchison, the port authority of Izmir or the CIY of 2010 does not have any relevant information which certifies this statement and for that reason, we cannon include it in our analysis.

The Damietta Container & Cargo Handling Co. (DCCHC) is a private company with mainly local roots in terms of shareholders. According to the last annual report of the port, the 42% of shares belongs to the holding company of maritime and land transport, the 25% to the Damietta port authority and the remaining 33% to a few local individuals and private companies. So, up to now in our research, this is the only private company, which does not operate under the umbrella of a global container terminal operator.

For the terminal of Port Said Container & Cargo Handling Co. (PSCCHC), we faced some problems with the data collection due to the fact, that much of the information

[29] Pier 3 will be operational ready in 2015.

is available only in Arabic. Nevertheless, we found that as in the case of the Damietta terminal, a relatively big percentage of the shares belong to the holding company of maritime and land transport. An important percentage belongs to individuals and private companies, while a relative small percentage belongs to the port authority of the terminal.

Finally, concerning the second container terminal of Port Said, which constitutes the last terminal of this analysis, the Suez Canal Container terminal (SCCT), we found that it is a joint venture private company and that it operates since October 2004. The majority of shares (55%) are held by APM Terminals; COSCO Pacific limited is holding the 20% of shares while the rest 25% is held by local parties (10% Suez Canal Authority, 10% Egyptian private sector, 5% National Bank of Egypt).

From the above analysis we identified that six of the eight private companies operate under the umbrella of the biggest global container terminal operations. In order to have a more complete view we can observe the following table.

Table 4.9: Distribution of global container terminal operators in the eastern and central Mediterranean region

GLOBAL CONTAINER TERMINAL OPERATORS	TERMINAL		PORT	COUNTRY
APMT	MEDCENTER CONTAINER TERMINAL	SUEZ CANAL CONTAINER TERMINAL	GIOIA TAURO, PORT SAID	ITALY, EGYPT
EUROGATE	MEDCENTER CONTAINER TERMINAL		GIOIA TAURO	ITALY
CMA CGM	MALTA FREEPORT TERMINALS		MARSAXLOKK	MALTA
EVERGREEN	TARANTO CONTAINER TERMINAL		TARANTO	ITALY
HPH	TARANTO CONTAINER TERMINAL		TARANTO	ITALY
COSCO PACIFIC	COSCO PACIFIC	SUEZ CANAL CONTAINER TERMINAL	PIRAEUS, PORT SAID	GREECE, EGYPT
TCE	TCE EGE KONTAYNER TERMINAL ISLETMELERI		IZMIR	TURKEY

source: Containerization International Yearbook 2010 & port authority sites

From this table, we can observe that only APM Terminals and COSCO Pacific are operating in more than one terminal in the ports of our examination. Nevertheless, the participation of such big players in the eastern and central Mediterranean Sea clearly shows how important this region is considered by global operators and liner companies. From those global operators (as we mention earlier), we can easily recognize the existence of some leader liner companies which are operating in the Mediterranean Sea. Liner companies such as the CMA CGM, EVERGREEN and COSCO are having extensive relations with those ports.

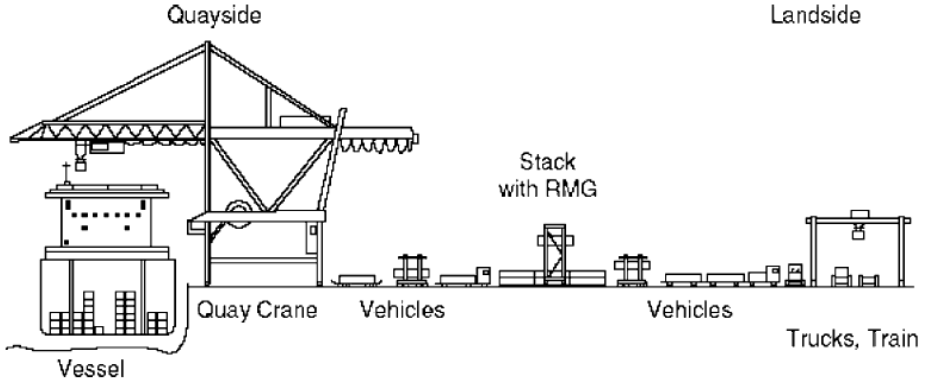
Concluding our analysis we have to remind that the participation of port authorities in the operation of the container terminals of the eastern and central Mediterranean region is until now very strong. They are directly operating six terminals but indirectly they have a noticeable participation in two more terminals in Egypt (DCHHC & PSCCHC). However, even in this case, the involvement of private global operators remains the most crucial element for the development of the port industry (Slack & Fremont, 2003). Moreover, the involvement of private companies in the terminals, increases, most of the times, the competitiveness of the ports (Lirn et al., 2003; Pardali, 2007).

4.4.2 Cargo handling equipment of the eastern and central Mediterranean ports

The aim of this analysis is the examination of the cargo handling equipment which is used in the container terminals of the eastern and central Mediterranean region. In the first part (4.4.2.1), we will present the quay cranes of each terminal while in the second part (4.4.2.2), we will focus on the yard cranes and vehicles of those terminals. In both cases, at the beginning we will analyze some basic elements of every equipment in order to have a better understanding of the topic and later, we will focus on the equipment that is been used in the ports of our selection. The scope of this effort is to understand the general trends about the cargo handling equipment that is been used in the selected ports, a subject we consider of great importance, since it is a key factor for the competitiveness of a port (according to: Brooks, 2000; Song & Yeo, 2004; Grosso & Monteiro, 2008; Pardali & Michalopoulos, 2008).

The equipment (which is) been used in a container terminal, influence dramatically the quality of the services offered by a port. Every harbor has different geometric layout, size and function; however, in principal, all container terminals have more or less a common system for loading/discharging and staking the containers. As we can see from the figure (4.7) below, when a vessel is docked and ready for the loading procedure, the quay cranes are discharging the containers from the containership. The next step, for an incoming container, is to be transferred, by the help of the vehicles from the quayside into the storage area. Then, the containers are stacked in the storage area and later, when they are needed, they are moved again on vehicles from the storage to the landside area. The final step is to be transferred by the help of rail or trucks, in their final destination, out of the terminal. Exactly the opposite procedure will be implemented for an export container.

Figure 4.7: Transportation & handling chain of a container



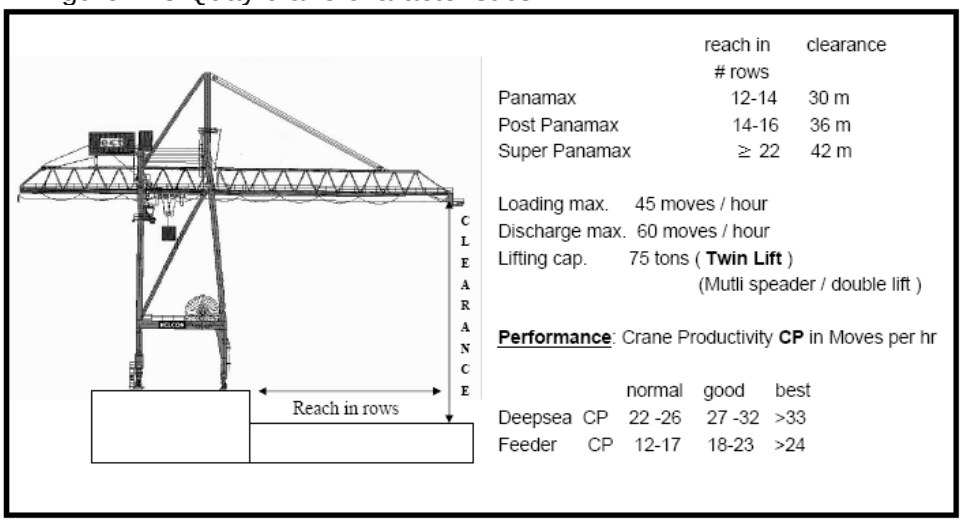
Source: Günther & Kim, 2006, p 440

Nevertheless, this is a simplified analysis of the row of the containers in the terminal. For example, the transshipment containers will be unloaded from a bigger containership (mother ship) and be loaded again in another smaller containership (feeder ship). So, in this case, the containers will not be transferred in the land side but they will be staked for a short period of time, before they are loaded again in another ship. In every case, the equipment plays critical role for the smooth operation of the terminal. In order to have a better understanding of the equipment in every examine port; we will present a separate analysis for the quay cranes and the yard cranes & vehicles in every terminal.

4.4.2.1 Quay cranes of the examinee ports

Starting our analysis with the quay cranes, we can categorize them in three different types: the Panamax, the Post Panamax and the Super Post Panamax (or Super Panamax). As we can see from the figure (4.8) below, every type of quay crane has different characteristics. The differences in a first level are between the clearance and the reach in number of rows. In a second level, one Super Post Panamax (SPP) crane can be different from another SPP crane, if it has some special characteristics such as dual trolleys or twinlift capability. In a general point of view, those differences influence dramatically the performance of a crane.

Figure: 4.8 Quay crane characteristics



Source: Bottema, 2010

Regarding the eastern and central Mediterranean ports, we can see from the table below (table 4.10), what kind of equipment every container terminal currently has. At this point, the reader has to keep in mind that small differentiations might occur with the present situation, due to the fact that the sources used may not have been one hundred per cent updated. Of course, it was not possible for us to acquire complete data, for most of the terminals, on the special characteristics of every quay crane and for that reason, we decided to focus only on the number and on the type of cranes. For that reason, we will not examine if those cranes have any special

capabilities (e.g. twinlift). Scope of this presentation is to identify the trend of the ports in the eastern and central Mediterranean region regarding this subject.

Table 4.10: The distribution of quay cranes in the E. & C. Mediterranean container terminals

PORT	TERMINAL	NUMBER OF QUAY CRANES (QC)	NUMBER OF PANAMAX QC	NUMBER OF POST PANAMAX QC	NUMBER OF SUPER POST PANAMAX	MOBILE CRANES
		Row A A=B+C+D	**Row B**	**Row C**	**Row D**	**Row E**
GIOIA	MEDCENTER CON.TER.	**22**	2	6	14	**2**
PORT SAID	SCCT	**12**			12	**0**
	PSCCH	**7**	1	3	3	**2**
MARSAXLOKK	TERMINAL ONE	**10**			10	**0**
	TERMINAL TWO	**9**		2	7	**0**
PIRAEUS	PPA CON. TER.	**7**	3		4	**1**
	PCT CON. TER.	**11**	2	5	6	**0**
HAIFA	EASTERN TERMINAL	**10**	4	4	2	**0**
	WESTERN & KISHON TER.	**6**		4	2	**2**
IZMIR	TURKIYE CUMHURIYETI DEVLET DEMIRYOLLARI	**5**		2	3	**14**
	TCS EGE CON. TER.	**4**	2		2	**2**
DAMIETTA	DAMIETTA CON. & CARGO HANDLING	**10**		6	4	**5**
ASHDOD	ASHDODO PORT	**10**		2	7	**2**
TARANTO	TARANTO CON. TER.	**10**		2	8	**1**

source: CIY 2010 & communication with various port authorities and terminal operators

In a general point of view, the mobile cranes (row E) in our table are mainly used[30] for the charging and discharging operation of the feeder ships and the RO-RO vessels (in special cases). The most important cranes however, in terms of productivity, are presented in the rows B, C and D. An important observation from this table is that most of the container terminals have invested in super post panamax quay cranes in order to be able to satisfy the demand of very large containerships. In two cases, (SCCT in Port Said and Terminal one in Marsaxlokk port) the terminals are operating only with super post panamax quay cranes. In some other cases, like the PCT container terminal, the future investment plans about the water side of the terminal is to replace almost all the smaller quay cranes with super post panamax cranes (according to the official site of PCT). Another important notice is that most of the container terminals are having a remarkable number of post panamax quay cranes in order to supply their services in the equivalent or lower size containerships. Concerning the panamax quay cranes we can say that in most of the times they are used for the provision of services in the feeder ships.

In this part of our analysis we have to mention that through the official sites of the port authorities and terminal operators, but most importantly through telephone communication we had with a few employees who worked at the operation and

[30] We came to that conclusion after telephone communication with some ports like the Damietta port and PPA terminal. However, this fact doesn't mean that some ports might use the mobile cranes for the loading/unloading operation of bigger vessels.

strategic management department of some ports[31], we came to the following conclusion: the general trend (at least for the ports in the eastern and central Mediterranean region) is for the terminal operators to invest mainly in super post panamax quay cranes and in less in post panamax cranes. The investment in panamax quay cranes is not very attractive and usually takes place in order to renew the obsolete cranes. The reason, based on their experience, is that the new and bigger quay cranes are more productive and flexible during their operation than the smaller quay cranes. Especially, during the peak periods, the super post panamax cranes can swiftly limit the congestion of a terminal, under the condition that the labor force is working productively under those conditions. Finally, the investment preference of the super post panamax is directly linked with the growth of the containerships. The main negative thing of this trend is the fact that the operation and investment cost for this type of quay cranes are very high. Nevertheless, as the same people mentioned, the previous benefits are much more important than the higher costs and in a long term, this type of investment can influence positively, not only the performance and profitability of the terminal but also the general image of the port.

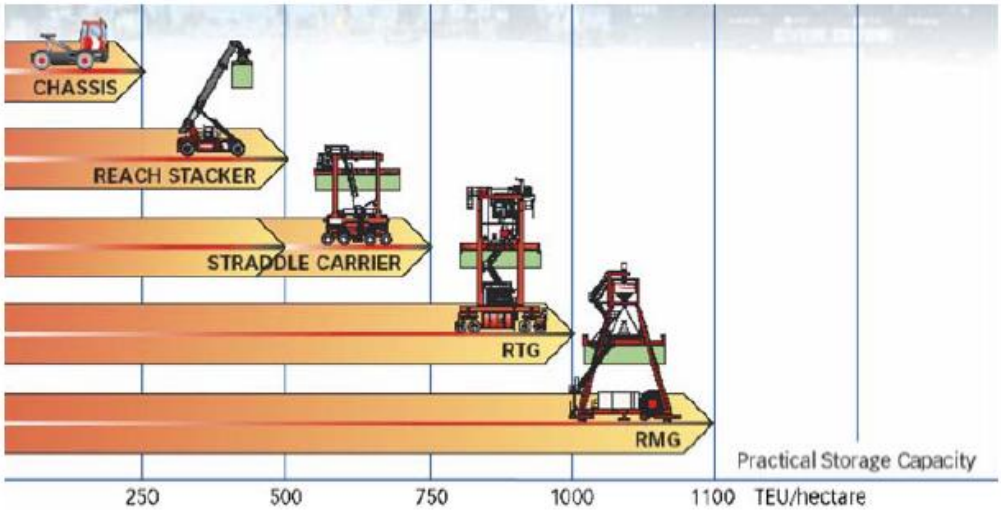
Concluding this part of our analysis we want to add an important comment that we have not heard from are interviewees. The implementation of technologically improved and bigger quay cranes is a very crucial element for a container terminal. Nevertheless, the one-side development in the terminal will increase the productivity of the water side, but it will most probably transfer the congestion (especially in peaks) in other parts of the terminal such as the storage area (Gunter & Kim, 2006). For that reason, such investments must be taken with respect to the total improvement of the container terminals. In other words, when a port is investing in better cranes it must invest also and in other elements of the terminal such as the vehicles that transfer the containers from the quay side to the storage side.

4.4.2.2 Yard cranes & vehicles in the examinee ports

In a general point of view, the most common types of yard cranes & vehicles are the rubber-tired gantry (RTG's) cranes, the rail-mounted gantry (RMG's) cranes, the straddle carriers, the reach stackers and the chassis-yard tractors (Gunther & Kim, 2006). Every type of those handling equipments influences in a different way, the planning, the operations and the utilization of a terminal (Rijsenbrij & Saanen, 2010). The figure 4.9 clearly shows how the most common handling equipments influence the land utilization. Using this figure as a tool and by the help of other sources we will try to briefly analyze the utility of every container handling equipment in the operation a container terminal.

[31] PPA container terminal, Piraeus Port; Terminal one, Marsaxlokk; Ashdod container terminal, Ashdod port

Figure: 4.9 Different types of land cranes & vehicles characteristics



Source: Günther & Kim, 2006

The first in series is the chassis or yard tractor and it has very low ratio TEU/hectare (approximately 250 TEU/hectare). The main disadvantage of this equipment is the fact that it is not capable for vertical transportation. In reality, the chasses are used for the transportation of the containers in the terminal (horizontal transportation). A more efficient way, for the transportation of containers is the multi trailer transportation system. This system can move larger number of containers in comparison with the single trailer system, which is implemented, most of the times, by the chasses.

Another handling equipment which is not included in figure 4.9 but it is important in our point of view is the container forklift. This vehicle is quite similar with the reach stacker with one main difference: the forklift holds the containers from the bottom. Concerning the TEU/hectare ratio, a forklift has more or less the same (depending from the model) ability considering the storage of containers.

As for the reach stacker, this is used for higher density container staking and so, compared with the chasses (and the forklift most of the times), it has higher ratio TEU/hectare (500 TEU/hectare). This vehicle is broadly used from many container terminals and in few cases, when a container is very heavy it is an appropriate mode for the container transportation inside the terminal[32]. This vehicle can be used for the transportation of containers inside the terminal as well as for the staking of containers in the storage area. Nevertheless, an important negative factor with the reach stackers is the fact that, in comparison with the straddle carriers, they do not have the same speed neither have the same flexibility in terms of operation (Rijsenbrij & Saanen, 2010).

[32] This conclusion came after a telephone communication that we had with an employee (how works in the operation department) of the PPA terminal.

The straddle carrier is one of the most efficient cargo handling equipments due the fact that it fits almost perfectly in both horizontal and vertical transportation of the containers (Steenken et al., 2004). It combines the functions of the stacking crane and the chasses. An important benefit for the straddle carrier is that it's capable to travel fully laden (close to 40 tons) at remarkable high speed (26-28[33] km/h). So, this fast speed provides flexibility in the operation of the terminal. Furthermore, this vehicle has other advantages such as: greater visibility, manouvrability and safety in the operations of a terminal (Rijsenbrij & Saanen, 2010). According to the Günther & Kim (2006) it can reach a storage capacity of 750 TEU/hectare. One important reason for this ratio is that by the use of straddle carriers, the space between the different rows of containers in the storage area can be minimized (in comparison with the previous cargo handling equipments).

The next cargo handling equipment of our analysis is the rubber-tired gantry (RTG) crane. Terminals which are using RTGs in their storage area are having higher and increased density and higher staking. More specifically, new RTGs can reach 1 over 5 staking high which is much better that the straddle carrier (1 over 2 or 1 over 3) (Rijsenbrij & Saanen, 2010). Nevertheless, we have not seen any serious automation in this type of crane as we have seen in the following item.

The rail-mounted gantry (RMG) cranes are having the highest staking in comparison with the previous equipment. The modern RMGs can easily reach a staking high of 1 over 6 containers and for that reason they can storage 1100-1200 TEU/ hectare (Rijsenbrij & Saanen, 2010). Many times, those cranes have double trolley in order to service more flexibly the demand for the storage of containers. This is the only equipment from all the examined ones, which has become half or fully automated (Rijsenbrij & Saanen, 2010).

Concluding this general analysis, we could not forget that in reality, other types of automated handling equipments exist also for the ship to yard transportation of containers. The most broadly known are the automated guided vehicles (AGVs) and the automated lifting vehicles[34] (ALVs). Both of them, minimize the labor cost and the human mistakes but they have higher investment cost. However, until nowadays the ALVs are rarely used by the container terminals while at the same time, the AGVs are becoming more preferable in some terminals such as the ECT Delta terminal in Rotterdam.

Continuing with the core part of our analysis, in the following table we can see how the land cranes and vehicles are distributed in the eastern and central Mediterranean region. In general, we were able (after many difficulties) to find information about most of the cargo handling equipments. However, due to the fact that we could not verify some of the data, in few cases, we decided to put "–" rather than to provide an unrealistic information. Moreover, we have to inform the reader, that the cargo handling equipment might change a little bit in the short term and so, maybe the data are not one hundred per cent accurate. Nevertheless, they are providing accurate enough information concerning the cargo handling equipment.

[33] Rijsenbrij & Saanen, 2010, p. 44

[34] The difference between an AGV and an ALV is that the last is capable of lifting the containers from the terrain by itself.

Table 4.11: The distribution of the land cranes & vehicles in the E. & C. Mediterranean container terminals

PORT	TERMINAL	YARD CRANES RTG'S	YARD CRANES RMG's	STRADDLE CARRIERS	REACH-STACKERS	CONTAINER FORKLIFTS	YARD TRACTORS / CHASSIS	MULTI-TRAILER TRACTORS
GIOIA TAURO	MEDCENTER CON.TER.	0	0	120	13	13	20	12 * 5 trailers
PORT SAID	ABBAS QUAY	0	0	0	5	-	12	-
	SCCT	7	0	0	8	-	87	-
	PSCCH	7	0	0	41	15	50	-
MARSAXLOKK	TERMINAL ONE	16	2	0	-	-	40	6*5 trailers
	TERMINAL TWO	10	7	0	5	-	81	5*5 trailers
PIRAEUS	PPA CON. TER.	0	8	10	12	-	10	0
	PCT CON. TER.	0	0	42	8	3	21	0
HAIFA	EASTERN TERMINAL	0	8	0	8	25	42	-
	WESTERN & KISHON TER.	0	7	12	4	19	24	-
IZMIR	TURKIYE CUMHURIYETI DEVLET DEMIRYOLLARI	16	0	0	23	20	36	0
	TCS EGE CON. TER.	5	0	0	5	8	10	0
DAMIETTA	DAMIETTA CON. & CARGO HANDLING	10	0	0	6	19	55	0
ASHDOD	ASHDODO POR CO	24	10	0	19	-	56	4*5 trailers
TARANTO	TARANTO CON. TER.	24	0	0	3	-	43	-

Source: Containerization International Yearbook 2010 & communication with various port authorities and terminal operators

Taken under consideration the results of the table 4.11, we can observe some very important clues from our research.

Regarding the vehicles which are operating in the ship to yard transportation of the containers we can observe the following things: At first, all the terminals are using more or less the yard tractors-chassis for the transportation of containers. Yet, in few cases, such as the Gioia Tauro, Marsaxlox and Ashdod ports the implementation of multi trailer tractors is considered a more preferable solution rather than the single trailer system. Moreover, in the Gioia Tauro and Piraeus ports, the straddle carriers are selected and are most broadly operating for the ship to store transportation. At this point, we have to mention that no AGV (or ALV) operate in the examined ports and so, we can come to the conclusion that no automation has been implemented for the ship to yard area of those terminals.

As for the higher density stacking equipments (RTGs & RMGs), which are operating in the storage area (and in the landside part of the terminal), we came to the following conclusions: An important observation was that almost all the terminals are using RTGs or/and RMGs in the terminals. Only in two cases (PPA container terminal and Medcenter container terminal), no one type of those cranes was operating in the terminal and this for the following reasons. According to the communication we had with the Piraeus port authority, until a some years ago it was considered not strategically important to use those types of cranes for the operation of the terminal and they were used to operate mainly straddle carriers and reach stakes. Nevertheless, due to their shift of their strategic goals, nowadays they have started to operate 8 new RMG's. Considering the Medcenter container terminal we notice that it is the only terminal which is operating mainly with straddle carriers. In fact, it has 120 straddle carriers which is an extremely big amount of equipment if you consider that the next in rank is the PCT container terminal with 42 straddle carriers. The Gioia Tauro terminal has a very unique operating strategy which has been proven successful, especially during the peak periods[35]. Considering the rest of the terminals, we can see that until nowadays, more RTGs than RMGs have been chosen for the yard area of the terminals. Especially in some ports, the number of RTG's is relatively big and in most of the times, those terminals are using these yard cranes for the storage of empty and full containers. At this point we have to make clear that many of the ports are having different investment strategies for the

[35] This is the personal view of an employee who works in the operation department of this terminal.

stacking cranes. For example, both the container terminals in Piraeus port are investing more in RMGs than in RTGs. On the other hand, the two container terminals of Marsaxlokk port will invest in more than five RTGs by end of 2012[36]. So, in a general point of view, we could not find (as we found in the quay crane case), a general trend for the future development of the yard cranes. Some ports in the range of our examination prefer more RMGs while at the same time, some others invest more is RTGs.

Even with those different strategies one common characteristic exists between most of the examined ports. This is the combination of more than one equipment used for the storage of the containers in the yard area. This is logical if we consider that the stacking procedure works in an extremely complicated environment with different operational needs[37]. In that sense, it would be extremely difficult one cargo handling equipment to be capable to satisfy all operational needs of the storage area. Even in the case of Gioia Tauro terminal, the 120 straddle carriers are the most important equipment for the storage area but are still using some reach stackers for their operations.

Before we conclude this part of our analysis we have to add one more important observation. The ports in the eastern and central Mediterranean region have not implemented any serious automation in the storage area. Maybe some containers (which we couldn't verify) have semi-automated or automated RMGs. However, most of the terminals with RMGs in their yard area, are not having automated or semi automated cranes.

To sum up, the ports of eastern and central Mediterranean region do not have any remarkable levels of automaton nor in ship to storage transportation of containers and neither in the storage area. Furthermore, because the operation environment of a container terminal is extremely complicated, all the container terminals are using a combination of cargo handling equipments. Finally, even if we have observed that the container terminals are operating more with RTGs, than with RMGs no serious conclusion can be made about the future trend of those yard cranes due to the fact that some ports invest in RTGs while some others invests in RMGs.

[36] Containerization International Yearbook 2010, p. 46

[37] For instance, in order to exist in a terminal higher yard utilization, the empty containers are traditionally stored in a higher staking level (in compassion with the full containers).

Chapter 5: Identification and measurement of E. & C. Mediterranean inter-port competition

5.1 Introduction

The fifth chapter is separated into two parts. In the first part, we implement the analysis of variance (ANOVA) technique in order to identify the container handling competition among the nine E. & C. Mediterranean ports. We have introduced the analysis of variance in the previous chapter. In the second part, the benchmarking technique is used to measure the inter-port competition among these container ports.

5.2 Identification of port competition with one-way anova analysis

We implement the one-way anova analysis to identify the competition among the nine E. & C. Mediterranean ports. In our case, the categorical variable (factor) is the port, with nine levels (nine ports) and the response variable is the traffic volumes in TEUs of each port for the period from 2003 to 2009.

We are interested to evaluate if there are significant differences among the nine ports' mean traffic volumes in TEUs.

Specifically, we conduct the following hypothesis test:

$H_0 : \mu_1 = \mu_2 = ... = \mu_9$, i.e. there is no significant difference among the nine ports' mean traffic volumes in TEUs

vs

$H_1 : \text{at least two of } \mu_1, \mu_2, ..., \mu_9 \text{ differ each other}$, thus there are significant differences among the nine ports' mean traffic volumes in TEUs.

where μ represents the population mean.

The following table presents the result of the one-way anova analysis conducted with SPSS 16.0 software.

Table 5.1: One-way ANOVA table

ANOVA					
TEU's					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	3.709E7	8	4635873.793	23.427	.000
Within Groups	1.069E7	54	197881.868		
Total	4.777E7	62			

Source: SPSS 16.0 calculation based on data from port authorities and various sites.

The F ratio is large, $F(8,54) = 23.427$, and the associated p-value is small (Sig=0.00<0.05). This leads to the rejection of the null hypothesis, thereby concluding that the means of the ports are not all equal. There are significant differences in the nine Mediterranean ports' container traffic volumes.

However, a major limitation of the previous one-way anova results is that we do not know how the ports' mean traffic volumes in TEUs differ; we just know that they are not equal to each other. To resolve this, we use post-hoc tests. These are tests we conduct after we already know that there are differences among the means we are comparing. Among several post-hoc tests available, Tukey's honestly significant difference (HSD) is considered one of the most appropriate. It involves testing all possible pairwise comparisons (comparing sets of two) among the means and identifying those significantly different (see Appendix B). Furthermore, it organizes the means of the groups into "homogenous subsets". Subsets of means that do not differ from each other go into the same column, and subsets that do differ go into separate columns (see Appendix B). Groups that do not appear in the same column are significantly different from each other at $a = 0.05$

In our case, subset 1 includes ports of Ashdod, Taranto, Izmir, Damietta, Haifa and Piraeus with average cargo volumes ranging from 698 to 1,202 thousand TEUs. Subset 2 also includes Damietta, Haifa and Piraeus ports, together with Marsaxlokk, with mean traffic volumes ranging from 1,070 to 1,745 thousand TEUs. Subset 3 also includes the port of Marsaxlokk together with Port Said, with average cargo volumes of 1,745 and 2,120 thousand TEUs, respectively. Finally, we infer that Gioia Tauro port is a subset by itself - subset 4 - with average traffic of 3,182 thousand TEUs.

The fact that some ports appear in more than one subsets shows that there are not significant differences in the traffic volumes of containers among them. Consequently, competition among them is expected to be more intense.

Splits occur around the Damietta and Izmir ports, the Marsaxlokk and Piraeus ports, and Gioia Tauro port. These splits indirectly indicate ports of significantly different levels of throughputs in TEUs.

5.3 Measurement of inter-port competition in the E. & C. Mediterranean Sea

5.3.1 Methodology

In this sub-chapter, a model based on the benchmarking technique is proposed to measure inter-port competition and determine the position of ports in the eastern and central Mediterranean Sea. Its main attribute is the inclusion of any number of variables essential to the port operation and performance. These variables fall within two categories; a) the quality criteria, and b) the features, where each category has a number of subcategories.

The performance of each port is evaluated through the positioning process which involves the following calculations (Pardali & Michalopoulos, 2008):

1. Benchmarking scores of each one of the quality and features criteria variables.
2. Benchmarking scores of the average port for each one of the quality and features criteria variables.
3. The competitiveness degree (PCD) of every port in the eastern and central Mediterranean region.
4. The best score of the ports for each one of the quality criteria and features variables.

The model identifies the leader port in the eastern and central Mediterranean region using the criterion of the maximum number of best scores. This is further tested by running a correlation analysis between the maximum number of best scores and the PCD. Next, it determines the variation among a port and the average and leader ports in the market for each variable of quality and features criteria. Finally, it can pinpoint those variables that the port falls short.

We implemented the aforementioned methodology in the eastern and central Mediterranean container handling port market and with the hypothesis that the examinee ports are serving both the import-export and transshipment market. In reality, most of the examinee ports are serving more the transshipment activities (as we showed in chapter 4) than the imports-exports activities. Nevertheless, due to the fact that we couldn't collect any sufficient statistical data which proof if a container handling port is having only transshipment or import-export activities, we decided to benchmark those ports taking under consideration both activities. In other words, we examined both activities for those ports - even if for some of them the imports-exports activities are limited - because we couldn't (statistically) prove if an examinee container port has none imports-exports or none transshipment activity (for the year 2009). The same hypothesis was implemented by Pardali & Michalopoulos (2008) and Michalopoulos (2006) for the Mediterranean Sea.

5.3.2 The model

In order to measure the E. & C. Mediterranean ports' container handling competition with the benchmarking technique, we adopted the model proposed by Pardali & Michalopoulos (2008), which involved the following steps:

1. Two variable categories were created: the quality criteria (QC) and the features (FE).

2. The quality criteria (QC) can be divided into the subcategories below:
   - IT systems
   - Application to cargo/containers
   - Others

3. The features (FE) can also be divided into the subcategories below:
   - Supply
   - Demand
   - Labour
   - Application to cargo/containers
   - Others

4. A number of variables according to Pardali & Michalopoulos (2008) and Pardali (2007) were incorporated in each of the subcategories so that they were described in the best possible manner. The total number of variables proposed in this model is 18 (14 for the features and 4 for the quality criteria variable categories) and all of them refer to 2009. From our literature review (chapter 2, 2.4), each one of these 18 variables proved to be a component which influences the port competiveness. More variables relevant to port administration, operation and quality of port product could have been collected, but access to this kind of information was impossible as most of the port authorities refused to provide it. Table 5.2 provides a detailed description of the variables used by the proposed benchmarking model.

Table 5.2: Description of the model variables

CATEGORY	**SUBCATEGORY**	**VARIABLES**	**KIND OF VARIABLE**	**MEASUREMENT UNIT**
Features	Supply	Number of container terminals	Quantitative	Number
Features	Supply	Number of berths	Quantitative	Number

Features	Supply	Surface of container terminal	Quantitative	Thousand square meters
Features	Supply	Storage capacity	Quantitative	Thousand TEUs
Features	Supply	Reefer points	Quantitative	Number
Features	Supply	Max. depth	Quantitative	Meters
Features	Demand	Total container traffic	Quantitative	Thousand TEUs
Features	Labour	Service of gate	Quantitative	Hours/Week
Features	Labour	24/7 service for the ships	Qualitative	YES/NO
Features	Others	Rail connection	Qualitative	YES/NO
Quality criteria	Others	ISPS code	Qualitative	YES/NO
Quality criteria	IT systems	EDI operation	Qualitative	YES/NO
Quality criteria	Application to cargo / containers	CFS station	Qualitative	YES/NO
Quality criteria	Application to cargo / containers	Gate control	Qualitative	YES/NO
Features	Application to cargo / containers	Container cleaning services	Qualitative	YES/NO
Features	Application to cargo / containers	Container repair services	Qualitative	YES/NO

Features	Others	Intensity of surface area operation	Quantitative	TEUs/m^2
Features	Others	Intensity of equipment operation in the quay side	Quantitative	Thousand TEUs/ quay crane

source: Michalopoulos (2006)

5. The method of constant value was selected in order to quantify the qualitative variables. If a port had a characteristic then it took a standard number (one hundred); if the port hadn't this characteristic then it took a zero.

6. The statistics $BSCORE_{(QC_i)}$ and $BSCORE_{(FE_i)}$ (Benchmarking score of quality criteria QC and features FE) were created as:

$$BSCORE_{(QC_p)} = AVERAGE\left(\text{var}_1, \text{var}_2, ..., \text{var}_m\right)$$

$$BSCORE_{(FE_p)} = AVERAGE\left(\text{var}_1, \text{var}_2, ..., \text{var}_n\right)$$

Where m is the number of quality criteria (QC), n the number of features (FE), for each $p = 1,2,...,l$ where l is the number of ports in the eastern and central Mediterranean Sea.

7. The statistic benchmarking score ($BSCORE$) has been created as:

$$BSCORE = AVERAGE\left(\begin{matrix}P=l \\ \Pr ice_i \\ P=1\end{matrix}\right)$$

where $P = 1,2,...,l$ is the container ports of number l, Price is the value of each variable and $i = 1,2,...,k$ is the number of variables that have been taken into account. As considered, k is the sum of m (quality criteria) and n (features).

8. The statistic best score ($BestSCORE$) has been created as:

$$BestSCORE = Max\left(\begin{matrix}P=n \\ \Pr ice_i \\ P=1\end{matrix}\right)$$

Where $P = 1,2,...,n$ is the container ports of number n, Price is the value of each variable and $i = 1,2,...,k$ is the number of variables that have been taken into account. As considered, k is the sum of m (quality criteria) and n (features).

9. The statistic $BENCHp$ was created as:

$$BENCHp = AVERAGE\left(BSCORE_{(FE_p)}, BSCORE_{(QC_p)}\right)$$

Where $BENCHp$ is the total value of each port p for the total of variables of quality criteria and features.

10. The statistic Port Competitiveness Degree (PCD) has been created as:

$$PCDp = \frac{100 \cdot BENCHp}{\sum_{p=1}^{n} BENCHp}$$

Where $p = 1,2,...,n$ is the container ports of number n. Then, the Benchmarking scores of the quality criteria and features for each port were calculated together with the total Benchmarking Score for the total of ports. In this manner, a unique value for each quality criterion or feature variable as well as the total of variables has been created.

11. Best scores for each variable are measured and the port with the maximum number of best scores (the leader port in the eastern and central Mediterranean region) is determined.

5.3.3 The analysis

By implementing the previously described model, we initially calculated the benchmarking scores of the E. & C. Mediterranean ports for the features and quality criteria which are shown in tables 5.3 and 5.4 respectively.

Table 5.3: Benchmarking scores of features (by variable) of E. & C. Mediterranean ports in 2009

	BENCHMARKING SCORE
SUPPLY	
Number of container terminals	1.56
Number of berths	6.33
Surface of container terminal (Thousand sq. meters)	878
Storage capacity (Thousand TEUs)	32.91
Reefer points	975.11
Max. depth	16.19
TOTAL SUPPLY	**318.35**
DEMAND	
Total container traffic (Thousand TEUs)	1,541.22
TOTAL DEMAND	**1,541.22**
LABOUR	
Service of gate	119.56
24/7 service for the ships	77.78
TOTAL LABOUR	**98.67**
APPLICATION TO CARGO/CONTAINERS	
Container cleaning services	77.78
Container repair services	77.78
APPLICATION TO CARGO/CONTAINERS TOTAL	**77.78**
OTHERS	
Rail connection	77.78
Intensity of surface area operation	1.83
Intensity of equipment operation in the quay side	78.98
OTHERS TOTAL	**52.86**
FEATURES GRAND TOTAL	**283.06**

source: Own calculation based on data from port authorities and various sites.

Features are separated into five subcategories: Supply, demand, labour, application to cargo / containers and others with totals of 318.35, 1,541.22, 98.67, 77.78 and 52.86, respectively. Each one of these subcategories encompasses a different number of variables either quantitative or qualitative. The total value of the average E. & C. Mediterranean port for the features amounts to 283.06.

Table 5.4: Benchmarking scores of quality criteria (by variable) of E. & C. Mediterranean ports in 2009

	BENCHMARKING SCORE
INFORMATION SYSTEMS	
EDI operation	100
INFORMATION SYSTEMS TOTAL	**100**
APPLICATION TO CARGO/CONTAINERS	
CFS station	77.78
Gate control	88.89
APPLICATION TO CARGO/CONTAINERS TOTAL	**83.33**
OTHERS	
ISPS code	100
OTHERS TOTAL	**100**
QUALITY CRITERIA GRAND TOTAL	**91.67**

source: Own calculation based on data from port authorities and various sites.

Quality criteria are separated into three subcategories: IT systems, application to cargo / containers and others. Each one of them has qualitative variables which have been quantified according to the method described in the previous section. The average E. & C. Mediterranean port gets the absolute value (100) in EDI operation and ISPS code[38] and a total benchmarking score of 91.67 for the quality criteria.

[38] This is a logical outcome for the European ports due to the European mandatory implementation of the ISPS Code from 01/07/2004.

5.3.3.1 The average Mediterranean port

Table 5.5 presents the benchmarking scores calculated for each port, together with the mean of all ports for the features and quality criteria. It provides an initial evaluation of each port's position in the market by comparing its position with the average E. & C. Mediterranean port.

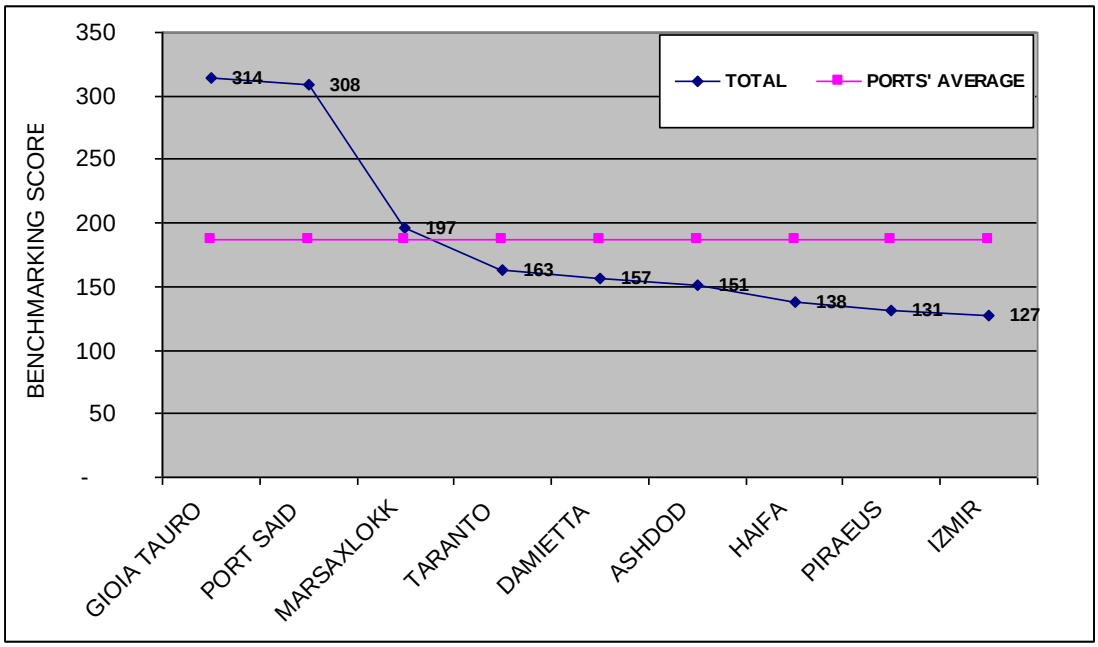
Table 5.5: Evaluation of benchmarking scores of E. & C. Mediterranean ports in 2009

PORTS	FEATURES	QUALITY CRITERIA	TOTAL
GIOIA TAURO	528.76	100	314.38
PORT SAID	516.56	100	308.28
MARSAXLOKK	318.51	75	196.75
TARANTO	225.43	100	162.72
DAMIETTA	213.77	100	156.89
ASHDOD	202.07	100	151.04
HAIFA	201.22	75	138.11
PIRAEUS	162.69	100	131.35
IZMIR	178.49	75	126.75
PORTS' AVERAGE	**283.06**	**91.67**	**187.36**

source: Own calculation based on data from port authorities and various sites.

The average benchmarking score of all E. & C. Mediterranean ports for all the features and quality criteria is 187.36. The highest positive variation from this average is attained by Gioia Tauro hub port (314.38), followed by Port Said port (308.28). These two ports together with Marsaxlokk are differentiated from the rest of the Mediterranean ports which show scores below the average and therefore considered more competitive. The port of Piraeus gets one of the lowest total scores (131.35) among all ports. Figure 5.1 summarizes the previous inference.

Figure 5.1: Evaluation of benchmarking scores of E. & C. Mediterranean ports in 2009



source: Table 5.5

5.3.3.2 The Port Competitiveness Degree (PCD)

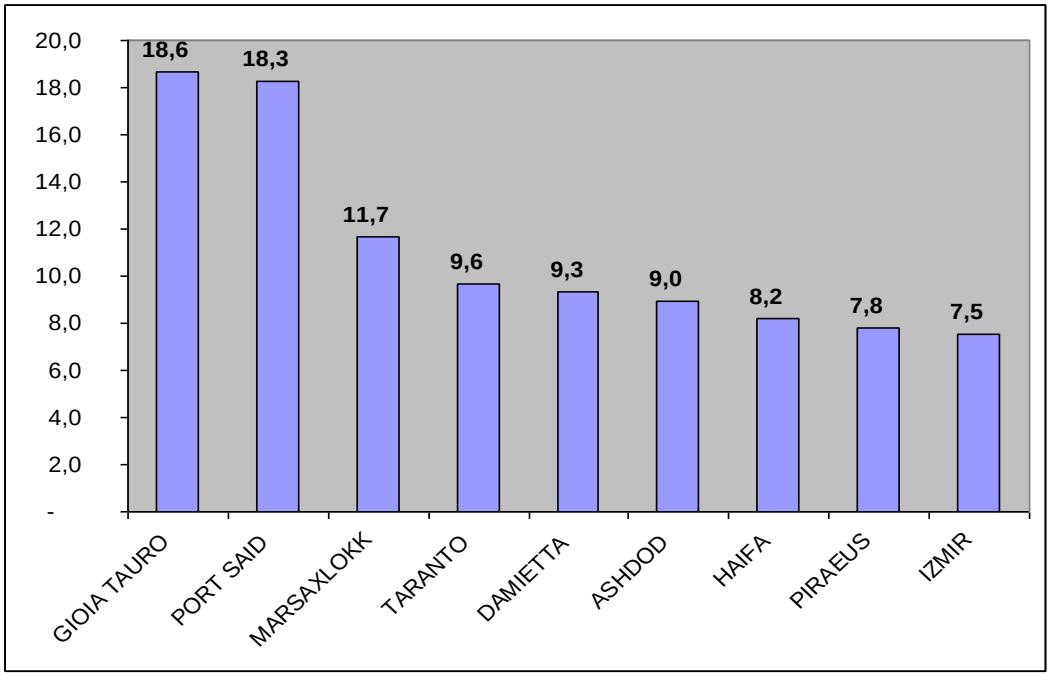
Table 5.6 and the corresponding diagram (Figure 5.2), depict the Port Competitiveness Degree (PCD) which is an index representing the proportion of each port in the total Benchmarking Score. According to the results, Gioia Tauro comes first with a competitiveness degree of almost 19, followed by Port Said which exhibits a PCD of 18. Marsaxlokk ranks third, while Taranto fourth. Damietta and Ashdod ports are almost equally competitive with a PCD of 9. The same is for Piraeus and Haifa with a PCD of 8.

Table 5.6: Competitiveness degree of E. & C. Mediterranean ports in 2009

RANKING	PORTS	COMPETITIVENESS DEGREE
1	GIOIA TAURO	18.64
2	PORT SAID	18.28
3	MARSAXLOKK	11.67
4	TARANTO	9.65
5	DAMIETTA	9.30
6	ASHDOD	8.96
7	HAIFA	8.19
8	PIRAEUS	7.79
9	IZMIR	7.52

source: Own calculation based on data from port authorities and various sites.

Figure 5.2: Competitiveness degree of E. & C. Mediterranean ports in 2009



source: Table 5.

5.3.3.2 Detecting the leader Mediterranean port

To find the leader Mediterranean port two criteria must be fulfilled (Michalopoulos, 2006); it must present the maximum number of best scores and a strong relationship between the maximum number of best scores and the Port Competitiveness Degree (PCD). The latter will be examined later with a correlation analysis. Table 5.7 presents the best score and the leader port(s) for each variable of the features category.

Table 5.7: Leader ports of the E. & C. Mediterranean Sea by features' variable in 2009

VARIABLE	BEST SCORE	LEADER PORT
Number of container terminals	2	PORT SAID, MARSAXLOKK, PIRAEUS, HAIFA, IZMIR
Number of berths	11	GIOIA TAURO
Surface of container terminal (Thousand sq. meters)	1,500	GIOIA TAURO
Storage capacity (Thousand TEUs)	70	GIOIA TAURO
Reefer points	2,350	GIOIA TAURO
Max. depth	18	GIOIA TAURO, PIRAEUS
Total container traffic (Thousand TEUs)	3,258	PORT SAID
Service of gate	168	PORT SAID, IZMIR
24/7 service for the ships	100	ALL EXCEPT FOR PIRAEUS AND HAIFA
Container cleaning services	100	ALL EXCEPT FOR HAIFA AND IZMIR
Container repair services	100	ALL EXCEPT FOR HAIFA AND IZMIR
Rail connection	100	ALL EXCEPT FOR MARSAXLOKK AND PIRAEUS
Intensity of surface area operation	3.58	MARSAXLOKK

Intensity of equipment operation in the quay side	129.77	GIOIA TAURO

source: Own calculation based on data from port authorities and various sites.

According to the results, Gioia Tauro port comes first as it achieves best score in 10 out of 14 feature variables, followed by Port Said which gets 7 out of 14 variables. On the other hand, Haifa excels only in 2 variables. Finally, Piraeus port excels in four feature variables.

Table 5.8 that follows classifies the Mediterranean ports, using the maximum number of best score quality criteria variables.

Table 5.8: Classification of E. & C. Mediterranean ports, using the maximum number of best score quality criteria variables in 2009

RANKING	PORTS	NUMBER OF BEST SCORE VARIABLES	% OF TOTAL OF VARIABLES
1	GIOIA TAURO	4	100
1	PORT SAID	4	100
1	PIRAEUS	4	100
1	DAMIETTA	4	100
1	ASHDOD	4	100
1	TARANTO	4	100
2	MARSAXLOKK	3	75
2	HAIFA	3	75
2	IZMIR	3	75

source: Own calculation based on data from port authorities and various sites.

We infer that there is more than one port (Gioia Tauro, Port Said, Piraeus, Damietta, Ashdod and Taranto) that achieves the best score for all of the quality criteria; something which makes the identification of the leader port difficult.

Therefore, we ordered all the ports based on the maximum number of best scores that each one gets for all of the analysis variables (18 variables). Table 5.9 and corresponding figure 5.3 display the classification of the nine ports according to the

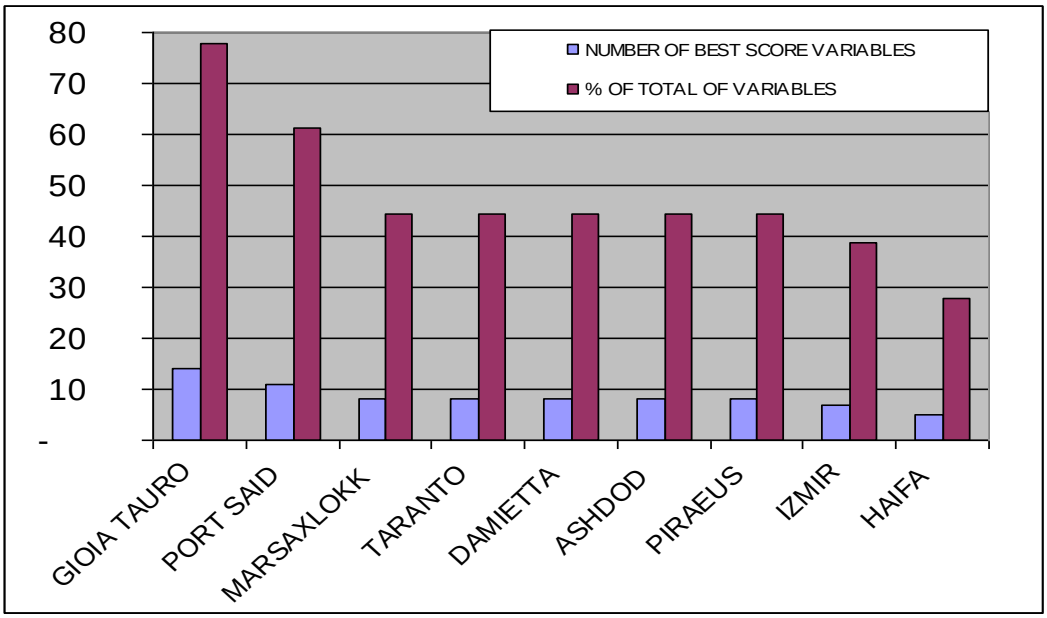
percentage of the variables where each port exhibits a Best Score. The E. & C. Mediterranean leader port is the one with the highest percentage that stands for an index of best performance in the 18 different port variables.

Table 5.9: Classification of E. & C. Mediterranean ports, for the total of variables, using the maximum number of best score variables in 2009

RANKING	PORTS	NUMBER OF BEST SCORE VARIABLES	% OF TOTAL OF VARIABLES
1	GIOIA TAURO	14	77.78
2	PORT SAID	11	61.11
3	MARSAXLOKK	8	44.44
3	TARANTO	8	44.44
3	DAMIETTA	8	44.44
3	ASHDOD	8	44.44
3	PIRAEUS	8	44.44
4	IZMIR	7	38.89
5	HAIFA	5	27.78

source: Own calculation based on data from port authorities and various sites.

Figure 5.3: Classification of E. & C. Mediterranean ports, for the total of variables, using the maximum number of best score variables in 2009



source: Table 5.9

From the previous results we infer that Gioia Tauro is the first port for this classification, as it achieves the best score in 14 out of 18 variables (77.78 %), followed by Port Said which gets best score in 11 out of 18 variables (61.11%) and the ports of Marsaxlokk, Taranto, Damietta, Ashdod and Piraeus, which succeed in best score values equally (8 out 18 variables, 44.44%).

Next, we conducted correlation analysis[39] (see Appendix D) to examine if the number of best score variables is associated, and in which way, to the Port Competitiveness Degree (PCD) that was calculated in section 5.3.3.2. We concluded that there is a statistically significant positive relationship (Pearson coefficient=0.890, Sig.=0.001<0.05) between the number of best scores that was measured as percentage in the total of the 18 variables and the PCD as it was measured with the benchmarking method.

From all the previous results we conclude that the port of Gioia Tauro is the leader port in the Mediterranean, as it achieves the highest percentage of best scores (77.78%) and simultaneously the highest Port Competitiveness Degree (almost 19).

A comparison between the features and quality criteria of Gioia Tauro port - the leader Mediterranean port in 2009 - and the port of Piraeus enables us to detect those port operations that need to be established or modified in order for Piraeus to improve its place in the market or become a leader port. This will be discussed in the following section.

[39] This analysis was conducted with SPSS 16.0 software

5.3.4 The position of Piraeus port in the competitive environment of the Mediterranean Sea

5.3.4.1 Comparison of features

Table 5.10 presents the benchmarking scores of features (by variable) of Piraeus port compared to the other Mediterranean ports. Excluding the application to cargo/containers subcategory, Piraeus port falls short compared to the average Mediterranean port in all of the other features' subcategories (supply, demand, labour, and others)

Table 5.10: Benchmarking scores of features (by variable) of Piraeus compared to the other E. & C. Mediterranean ports

	PIRAEUS BENCHMARKING SCORE	**AVERAGE MEDITERRANEAN PORT**	**MEDITERRANEAN BEST SCORE**
SUPPLY			
Number of container terminals	2	1.56	2
Number of berths	7	6.33	11
Surface of container terminal (Thousand sq. meters)	900	878	1,500
Storage capacity (Thousand TEUs)	43.39	32.91	70
Reefer points	288	975.11	2,350
Max. depth	18	16.19	18
TOTAL SUPPLY	**209.73**	**318.35**	**658.50**
DEMAND			
Total container traffic (Thousand TEUs)	665	1,541.22	3,258
TOTAL DEMAND	**665**	**1,541.22**	**3,258**
LABOUR			
Service of gate	112	119.56	168

24/7 service for the ships	0	77.78	100
TOTAL LABOUR	**56**	**98.67**	**134**
APPLICATION TO CARGO/CONTAINERS			
Container cleaning services	100	77.78	100
Container repair services	100	77.78	100
APPLICATION TO CARGO/CONTAINERS TOTAL	**100**	**77.78**	**100**
OTHERS			
Rail connection	0	77.78	100
Intensity of surface area operation	0.74	1.83	3.58
Intensity of equipment operation in the quay side	41.56	78.98	129.77
OTHERS TOTAL	**14.10**	**52.86**	**77.79**
FEATURES GRAND TOTAL	**162.69**	**283.06**	**565.03**

source: Own calculation based on data from port authorities and various sites.

Specifically, total supply in Piraeus was calculated 209.73 compared to 318.35 of the average E. & C. Mediterranean port. Piraeus exceeds in number of berths (7 to 6.33), surface of container terminal (900 to 878 thousand square meters), storage capacity (43.39 to 32.91 thousand TEUs) and maximum depth (18 to 16.19 meters), while it falls short in reefer points (288 to 975.11). Finally, the number of container terminals almost identifies with that of the average Mediterranean port; 2 to 1.56.

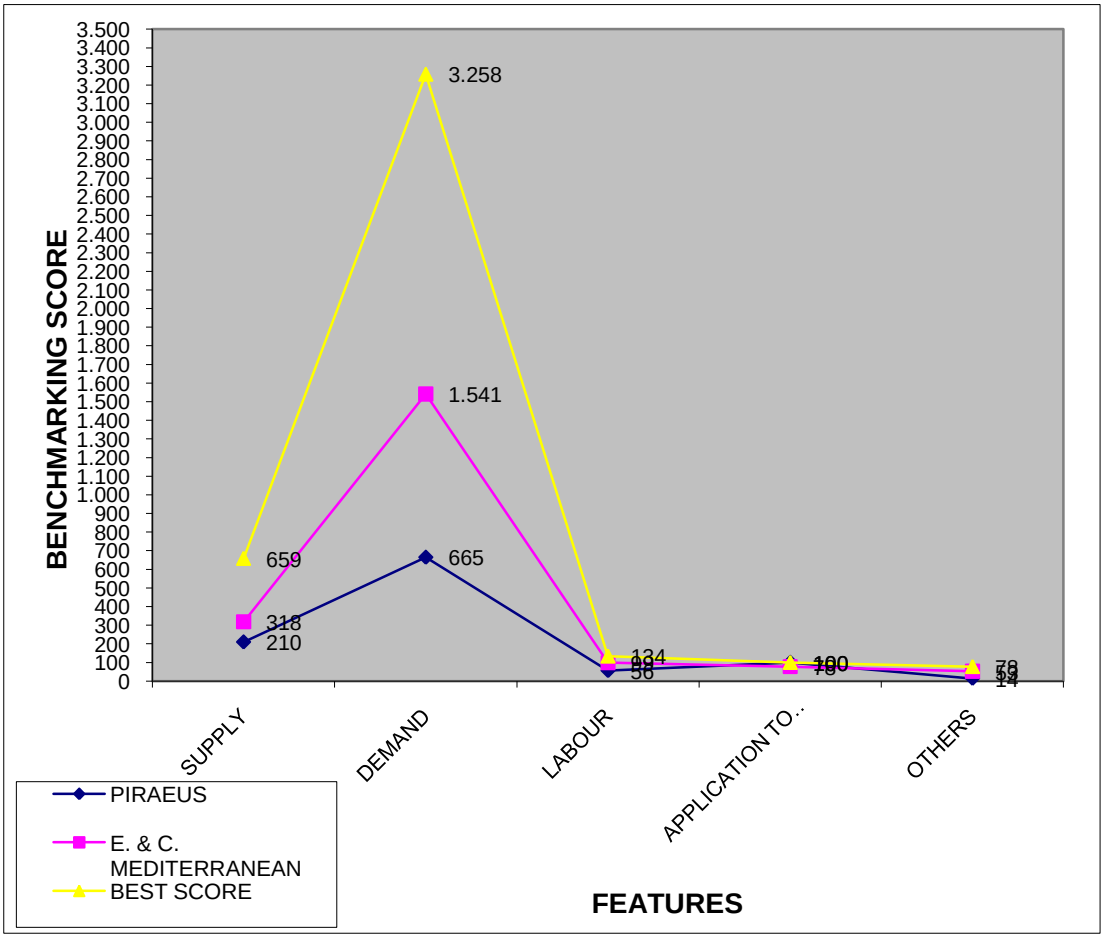
Concerning demand, Piraeus has lower value in total container traffic (665 to 1,541.22 thousand TEUs). As to labour, it falls short in service of gate (112 to

119.56 hours per week) and 24/7 service for the ships. The latter takes zero as Piraeus port operates less than 365 days per year. The strikes during the year 2009 had negatively influenced this variable.

As to application to cargo/containers subcategory, Piraeus excels at container cleaning services (100 to 77.78) and the same is for container repair services.

Finally, others subcategory also falls short (a total of 14.10 compared to 52.86). This is due to the fact that Piraeus has no connection with the railway network (takes zero). Furthermore, it presents smaller values in intensity of surface area operation (0.74 to 1.83 TEUs per square meter) and intensity of equipment operation in the quay side (41.56 to 78.98 TEUs per quay crane). Figure 5.4 that follows recapitulates the previous subcategory level conclusions.

Figure 5.4: Benchmarking scores of features (by subcategory) of Piraeus compared to E. & C, Mediterranean ports



source: Table 5.10

5.3.4.2 Comparison of quality criteria

This section compares the benchmarking scores of quality criteria (by variable) of Piraeus port to the other E. & C. Mediterranean ports.

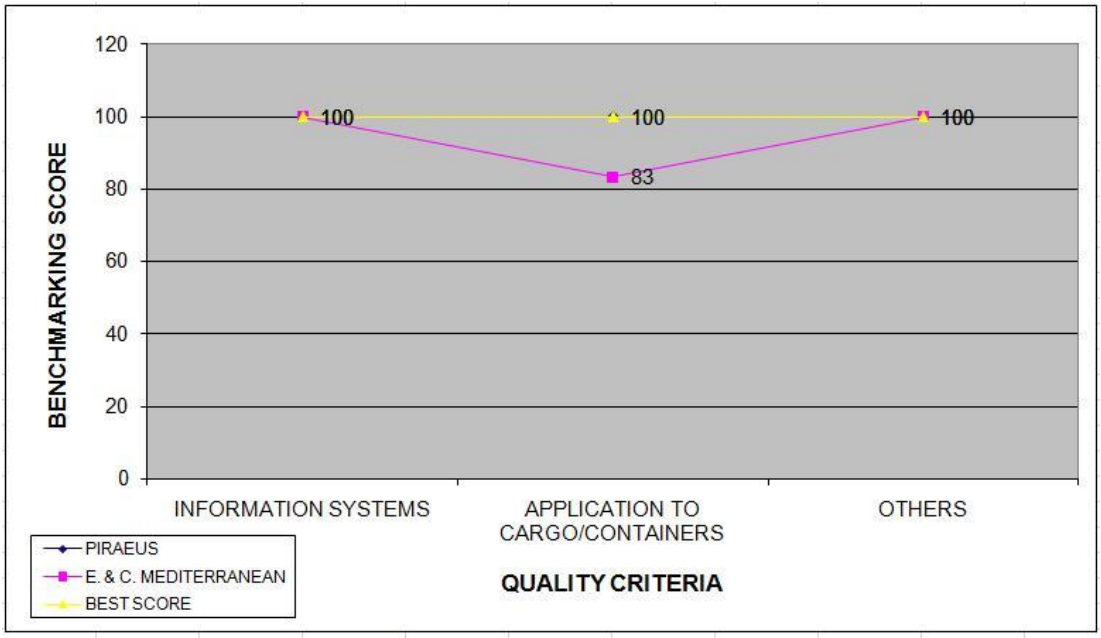
Table 5.11: Benchmarking scores of quality criteria (by variable) of Piraeus compared to the other E. & C. Mediterranean ports

	PIRAEUS BENCHMARKING SCORE	**AVERAGE MEDITERRANEAN PORT**	**MEDITERRANNEAN BEST SCORE**
INFORMATION SYSTEMS			
EDI operation	100	100	100
INFORMATION SYSTEMS TOTAL	**100**	**100**	**100**
APPLICATION TO CARGO/CONTAINERS			
CFS station	100	77.78	100
Gate control	100	88.89	100
APPLICATION TO CARGO/CONTAINERS TOTAL	**100**	**83.33**	**100**
OTHERS			
ISPS code	100	100	100
OTHERS TOTAL	**100**	**100**	**100**
QUALITY CRITERIA GRAND TOTAL	**100**	**91.67**	**100**

Source: Own calculation based on data from port authorities and various sites.

The total score of the port of Piraeus was 100 compared to 91.67 of the average E. & C. Mediterranean port. Specifically, Piraeus has a higher value in application to cargo/containers subcategory (100 to 83.33), while it succeeds equally (100 to 100) in information systems and others subcategories (see also Figure 5.5 that follows).

Figure 5.5: Benchmarking scores of quality criteria (by subcategory) of Piraeus compared to E. &. C. Mediterranean ports



Source: Table 5.11

More specifically, it exceeds the performance of the average E. & C. Mediterranean port in CFS station (100 to 77.78) and gate control (100 to 88.89), while it succeeds equally in EDI operation (100 to 100) and ISPS code (100 to 100).

5.3.4.3 Analysis of hysteresis

In an attempt to discover what changes need to be made so that the port of Piraeus enhances its role and position in the Mediterranean Sea, we did hysteresis analysis between the port of Piraeus and, a) the average Mediterranean port, b) the leader port of Gioia Tauro.

First, we calculated the overhead degree of the variables that Piraeus falls short compared to the average E. & C. Mediterranean port and then the results were sorted in ascending percentage order (Table 5.12).

Table 5.12: Variables that Piraeus port falls short compared to the average Mediterranean port

VARIABLES	CATEGORY	% OF COVERAGE OF AVERAGE MEDITERRANEAN PORT
24/7 service for the ships	Features	0
Rail connection	Features	0
Reefer points	Features	29.54
Intensity of surface area operation	Features	40.48
Total container traffic (Thousand TEUs)	Features	43.15
Intensity of equipment operation in the quay side	Features	52.62
Service of gate	Features	93.68

source: Own calculation based on data from port authorities and various sites.

From a total of 18 variables used in the analysis, the port of Piraeus does not exhibit smaller scores than the average port in any of the quality criteria variables (see section 5.3.4.2). Instead, there is hysteresis in 7 feature variables. Specifically, two services are not provided by the Piraeus port (24/7 service for the ships and rail connection), and for the other five the overhead degree fluctuates from 29.54% (reefer points) to 93.68% (service of gate).

In order to quantify the hysteresis of the port of Piraeus from the leader port of Gioia Tauro, the variance between them for each variable of the feature and quality criteria was measured. Afterwards, the results were sorted in descending variance order (Table 5.13).

Table 5.13: Variances of benchmarking scores between the ports of Piraeus and Gioia Tauro in 2009

VARIABLE	CATEGORY	SUBCATEGORY	% VARIANCE
24/7 service for the ships	Features	Labour	-100.00
Rail connection	Features	Others	-100.00
Reefer points	Features	Supply	-87.74
Others total	Features	Others	-81.74
Total container traffic (Thousand TEUs)	Features	Demand	-76.71
Total demand	Features	Demand	-76.71
Features grand total	Features	-	-69.23
Total supply	Features	Supply	-68.14
Intensity of equipment operation in the quay side	Features	Others	-67.97
Intensity of surface area operation	Features	Others	-61.18
Surface of container terminal (Thousand sq. meters)	Features	Supply	-40.00
Storage capacity (Thousand TEUs)	Features	Supply	-38.02
Number of berths	Features	Supply	-36.36
Total labour	Features	Labour	-32.53

source: Own calculation based on data from port authorities and various sites.

The port of Piraeus shows higher values than the port of Gioia Tauro in only two variables: number of container terminals (+100%) and service of gate (+69.7%). Moreover, they have the same values in all four quality criteria variables; ISPS code, EDI operation, CFS station and gate control, as well as in the feature variables of maximum depth, container cleaning services and container repair services. So, from a total of 18 variables, Piraeus falls short in nine of them (all feature ones) with hysteresis degree ranging from -32.53% to -100%.

From the previous analysis, it was realized that the port of Piraeus is in a disadvantageous position compared to the port of Gioia Tauro for the following reasons:

- ❖ Operational less than 365 days per year
- ❖ Absence of connection to the national railway network
- ❖ Smaller availability of reefer points
- ❖ Smaller container traffic volumes
- ❖ Lower intensity of equipment operation in the quay side and of surface area operation
- ❖ Smaller surface of the container terminal
- ❖ Limited storage capacity of TEUs
- ❖ Limited number of berths

Consequently, to improve its competitiveness the port of Piraeus should do the following:

- ✓ Increase the operational days per year. This is directly connected to the smooth operation of the terminal without strikes like the one during 2009.
- ✓ Get connected to the national railway network. As a consequence, TEUs handling will become faster, more efficient and ultimately cheaper. In addition, traffic volumes of TEUs will also grow.
- ✓ Increase the number of power supplies for reefer points.
- ✓ Raise the number of berths taking into account the mean length of the container ships that dock.
- ✓ Extend the container terminal surface with simultaneous increase of TEUs' storage area.

Chapter 6: The Piraeus Port

6.1 Introduction

This chapter focuses on the case of Piraeus, without to take under consideration any other port in the E & C. Mediterranean region. At the beginning we provide some general information about the aforementioned port and later we analyze the two container terminals. We investigate the investments in each port and the individual strategies of those operators. Finally, we briefly analyze some other parameters which influence positively the competitiveness of the port.

6.2 Historical overview and geographical importance of the Piraeus port

Generally speaking, the superiority of a port in terms of geographical location (e.g. distribution of land and sea, accessibility of important sea routes) is a crucial competitive advantage that stays unchanged during the years. The Piraeus port has a strategic position in the eastern Mediterranean Sea. It is close to major sea routs and connects three continents (Europe, Asia and Africa). It has been for many centuries an import/ export port, up to a point, because it is directly related with the city of Athens, the most densely populated city in Greece. More particularly, the port of Piraeus is located to the southwest coast of Attica in the Saronic gulf cove, with exact coordinates 37°57'23"N 23°35'21"E (Mallikouti, 2004). The distance between the Piraeus and the city center is about ten kilometers and the development of the port has been strongly correlated with the development of Athens.

The port of Piraeus is one of the oldest harbors in the Mediterranean Sea and according to Tzelepis (1998), its activities began from the ancient times. These activities became intensive due to the strategic geographical location of the examined port. Nevertheless, other historical factors influence positively the progress of the port. According to the aforementioned author, during the last century, the development of this harbor became more intensive. More precisely, taking under consideration, information from the Piraeus Port Authority, we can indentify few important factors, which influence positively the progress of this harbor in the following table.

Table 6.1: Historical overview of Piraeus Port	
1924	Startup of large projects at the port
1930	Establishment of autonomous "Piraeus Port Authority"[40]
1959	Beginning of construction of the first passenger terminal
1978	Beginning of construction of the first container terminal
1986	Completion of extension projects of the container terminal
1999	Conversion of Piraeus Port Authority into a limited company
2003	Introduction of PPA in the Athens Stock Exchange (with 74.14% public ownership)
2009 (June)	Completion of investment plan of the PPA container terminal
2009 (Oct.)	Operation of PCT container terminal from SEP Inc. (subsidiary of COSCO Pacific)
source: Piraeus port authority	

From this table we can indentify how important were the last decades for the development of the Piraeus port. These changes influenced the structure, the organization and the operation of the port; but the most important factor is presented in the last row of this table. The establishment of such a global container operator in the Piraeus port will influence positively the competitiveness of the container port (Pallis and Vitsounis, 2008). We will analyze in-depth this parameter later on.

6.2 Different markets in which the Piraeus port provides its services

The port of Piraeus, like many other ports, provides a variety of services for its clients. Some of those services are: navigation, towage, mooring, loading/discharge of cargo, stacking organization, storage, information technology, telecommunications, supplies of ships (e.g. food, spare parts etc.), fuel supplies, etc. Some of these services are provided by private companies, while others by the Piraeus port authority. The aforementioned services satisfy the needs of different markets that operate in the port. We can identify the different markets in which the port operates taking under consideration its facilities. According to the Piraeus port authority official site, the port can be separated into two “different” ports: those are the passenger port and the commercial port. We will briefly analyze both of those concepts attempting to get a general understanding about the markets operating in that harbor. In appendix E, we provide a map of Piraeus port in order to understand the structure of the harbor.

[40] This is an important development due to the fact that from that moment the Piraeus port authority established the foundations so as the port was transformed from a traditional local port (with local management) into a national port with "independent” administration and operation.

a) Passenger port

The Piraeus passenger port is one of the most competitive ports in the world and more precisely, according to the PPA, it is the first in Europe and one of the biggest in the world (always, in terms of passenger movement). According to the aforementioned authority, the passenger port serves every year approximately 20 million passengers. Two types of services compose it: the cruise services and the costal shipping services. In order to give a proper depiction of the size of the passenger port, we calculated, that added together (cruise services & costal shipping services) both amount to more than 40 available berths.

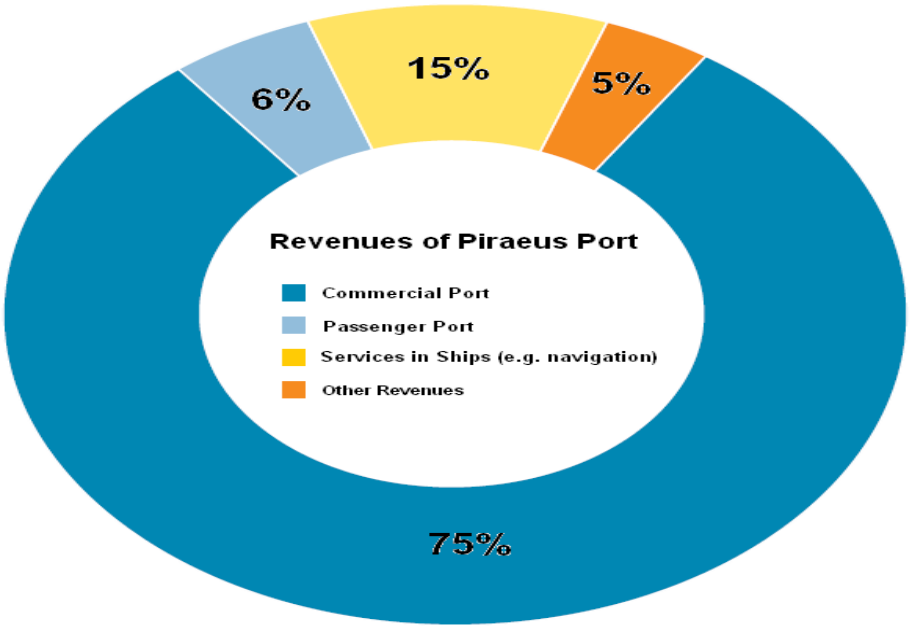
b) Commercial port

The commercial port of Piraeus includes many different terminals, which provide a variety of services to the users. Those terminals are scattered around the port and include the dry bulk cargo terminal, Ro-Ro terminal, liquid bulk cargo terminal, car terminal and container terminals (according to PPA official site). Every different market has a unique importance for the port and in some cases (like the case of the car terminal[41]) the administration has put serious efforts in order to increase the competitiveness of that specific market. These efforts include, among others, the development of the infrastructure, the IT systems and the creation of alliances with major companies (according PPA official site).

Generally speaking, we note that the commercial port, due to its intensive activities, is the main source of revenue for the port. To be more precise, we present figure 6.1, which portrays the distribution of revenues of this port. The 75% of these revenues comes from the commercial port while only the 6% comes from the passenger port. So, the commercial port can be characterized as more valuable, in terms of revenue for the port.

[41] Those affords have not yet succeed due to the very low demand for this market during the previous years.

Figure 6.1: Revenues of the Piraeus port



source: Piraeus port authority official site

Proceeding our analysis, we have to mention one more sector of the Piraeus port, which is responsible for the repair services of the ships: this is the shipbuilding and repair zone. During the last decades this sector has become very unattractive for the potential users; the few companies that exist in the broader geographical area are having no serious know-how, have no technological means, no sophisticated labor and in general, no skills for the shipbuilding of commercial vessels. In reality, mainly repair activities exist and the revenues from those operations are practically non existing. Nevertheless, in order to change this negative climate, the government and the port authority are trying to give life in this area. As an example, PPA has already set up a subsidiary for the Perama ship repair zone (Nafs PPA SA) and through an increase in share capital from private sources they are trying to modernize those services. Moreover, there is a possibility that a private company with global recognition will operate the shipbuilding zone in the future. COSCO has already showed its interest, encouraging its vessels that approach Piraeus port to have their repair services in the Piraeus shipbuilding & repair zone. This fact shows the willingness of COSCO to invest in the Piraeus port and in many different services concerning the shipping industry. However, this part of Piraeus is not the aim of our study and so we are not focusing in this market. Later we will present how COSCO is trying to expand its activities in other directly or indirectly related shipping services.

6.3 Historical background, investments and individual strategies of each container terminal

This is a very important part of our analysis because we will observe how the investments and the individual strategies of each container terminal influence the competitiveness of the port. In both terminals we present the same structure: at the beginning we provide a historical background of the terminals and later we provide the investment plans of those operators concerning the terminal. Finally, we mention a few crucial strategies that each terminal has, intending to achieve a competitive advantage.

6.3.1 The Piraeus Port Authority (PPA) container terminal

6.3.1.1 Historical background

The container terminals of the Piraeus port are located in N. Ikonio. Until the end of September of 2009, the Piraeus port authority was operating all the area of the terminal (Pier 1 & 2) by itself. The name of the terminal until that period was El. Venizelos. From October 1st 2009, El. Venizelos was divided into two terminals and the Port's authority operate only the smaller part (in terms of size) of the total area (see Appendix E). This part (Pier 1) was renamed as PPA container terminal. This way the monopolist nature of services became a duopoly.

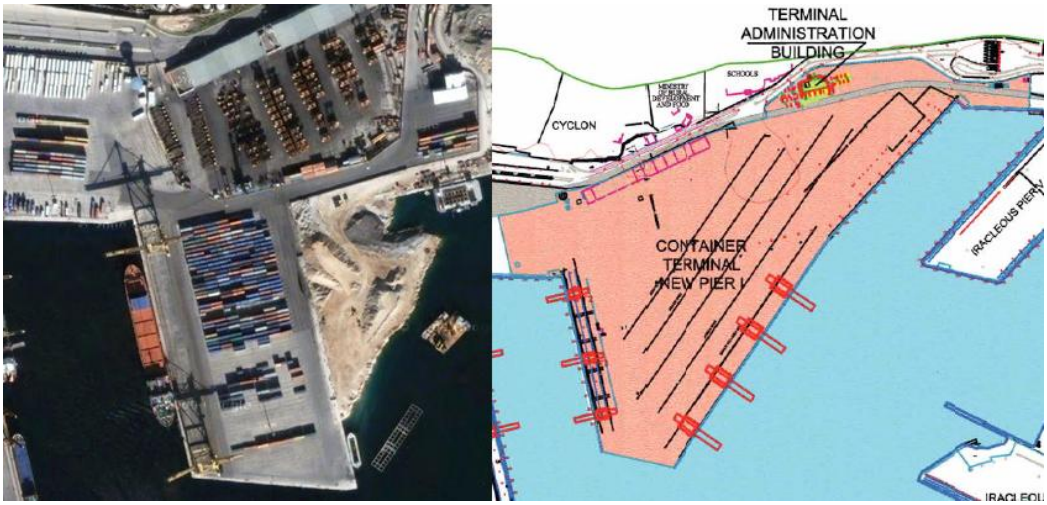
6.3.1.2 The investments in PPA container terminal

The Piraeus port authority invested in its terminal in an attempt to shift the port's competitiveness, rendering it more attractive to the shippers. This was a necessary step because the port was lucking remarkable number of facilities (as we showed in chapter 5). The investment plan was based on the investment plan of 2002 (according to an interview that Mr. Anomeritis[42] gave in the monthly magazine "Efoplistis"). In those days, the plan also included Pier 2, however, in these days the attention of PPA focused only on Pier 1 (PPA container terminal). Nevertheless, the investment plan of this terminal, cost more than 160[43] million euros (according to PPA official site) and for that reason, PPA has undertaken two loans from the European Investment Bank. According to Mr. Tsimplakis (2009), the aforementioned loans covered the biggest part of the money that the PPA needed (90[44] million). The

[42] Mr. Anomeritis is the president and CEO of Piraeus port authority according to the official site of PPA.
[43] Without Value Added Tax
[44] The European investment bank has given until now two loans: one in 2005 (35 million euro) and one more in 2009 (55 million euro).

rest of the money[45] came from PPA's own funds and from EU financing (3rd Framerwork Program). The realization of the investment plan started a few years ago and finished on June 1st 2010 (according to PPA official site). From this day the PPA terminal is capable to provide services at full speed (according to Mr. Anomeritis's aforementioned interview). In reality, there was a small delay but until the moment that we are writing these words; the port has completed almost every unfinished investment.

Figure 6.2: Map of 2009 & present layup of PPA container terminal



source: Google maps & Piraeus port authority official site

According to PPA's official site, the investment plan of the 160 million euros, entailed the following things:

- Modernization of the terminal quay cranes. The port invested in 4 new Super Post Panamax[46] quay cranes, in 3 new Panamax[47] quay cranes and in one new mobile crane (for feeder services). Due to the installation of the new cranes the eastern quay wall is capable to serve mother ships (with 18 m. max depth) while the western quay is used mainly for feeder ships (with 12 m. max depth).
- 8 RMG's (Rail Mounted Gantries) for the staking of the containers. According to the interview that we had with Prof. Karli, we now that these cargo handling machines are semi-automated.
- Modern and upgraded IT system. The PMIS (Port Management Information Systems), is automated and in this way documents and critical information

[45] According to the aforementioned author and the PPA official site.
[46] According to PPA official site the technical characteristics are the following: lifting capability of 65 tn, capacity to handle up to 22 container rows in length, out reach 60m, back reach 20m.
[47] According to PPA official site the technical characteristics are the following: lifting capability of 65 tn, capacity to handle up to 13 container rows in length, out reach 38m, back reach 16m.

can be transferred faster and safer; for example, the new system has the ability to provide to the customers direct transaction services.
- The expansion of the total area of the port by 250.000 sqm.
- The construction of an administration building for the needs of the port authority. This construction covers a total area of 4.000 sqm.

In the interview that we had with Prof. Karli he mentioned that there is also a possibility to invest in two RTG's in the following years. However, until the moment that we are writing this thesis, no official statement specifies if and whether PPA will eventually actuate this investment.

Concluding, we have to mention that the scope of this investment plan is for the PPA container terminal to be capable to handle an annual throughput of 1.000.000[48] TEU's.

6.3.1.3 Individual strategies for the increase of the competitiveness in the PPA container terminal

Besides the aforementioned strategic investments, which will shift the competitiveness of the terminal, we can also identify other individual strategies of the operator, which can further make the terminal more attractive for business. These strategies include mainly two important elements: the labor structure and the pricing policy of the PPA container terminal.

a) Labor structure

As we have proved in chapter 2, the sophisticated, skilled and stable[49] labor in a container terminal, influence dramatically the competitiveness of a port (Huang et al., 2003; Cullinane et al., 2004; Tongzon & Heng, 2005; Yeo et al., 2008). So, if a container terminal does not have a stable labor force, then the competitiveness most probably will decrease along with the world-wide image of the port. This exact problem is present for many years in the Piraeus container port. The roots of this problem began many decades ago when each government hired hundreds of people for electioneering purposes. During the last year however the situation changed for the better for the following reasons. Firstly, the PPA issued a voluntary redundancy program for its workers. The number of the employees that left with the voluntary redundancy program was 173 (according to the interview that we had with Prof. Karli). At this point, we have to mention that many of those workers used to work in other areas of the port (e.g. dry bulk cargo terminal). However plenty of them used to work in the terminal, which nowadays is operated by the COSCO Pacific Company. Secondly, the Piraeus port authority announced the termination of the co-operation with some private companies (e.g. stevedoring companies) which were

[48] According to the PPA official site this number can achieved under the following conditions: 1) annual coverage of storage area to be higher than 69% for the empty containers and higher that 76% for the full containers. 2) Mix between transshipment and local 40:60. 3) The average storage time of the container in the terminal (dwell time) to be 7 days.
[49] Without strikes

traditionally providing a variety of services in the containerships. In that way, the existing employees will be start working more intensively and will develop the necessary skills in areas, which they were not utilized until now. Thirdly, the port authority of PPA terminal is trying to improve the skills of their employees by providing them with seminars and other educational programs, in an attempt to familiarize them with the new equipment and the new responsibilities. Finally, the new regulations for the operation of the terminal are stricter and directly related to the achievement of better operational results. In that sense, the new regulations were created, taking under consideration the respective regulations of the Piraeus Container terminal. So, based on regulations from a more experienced operator (COSCO) the PPA is trying to increase its competitiveness. In reality most of the aforementioned labour strategies are been implemented by PPA also in other terminals of the Piraeus port.

b) pricing policy

The Piraeus port author had been deeply damaged during the last years not only because of the global crisis but also because of the strikes of its employees. In order to reverse this negative climate and to attract more customers the authorities decided not to change prices for the years 2009 and 2010 (mainly, cargo handling cost). In that way, they are trying to gain customers, who prefer low cost services and do not care so much about certain inconveniences while being serviced. We have to mention that this pricing policy has been used also in other markets of the port (e.g. dry bulk cargo terminal).

6.3.2 The Piraeus Container Terminal (PCT)

6.3.2.1 Historical background

The background of the privatization in Piraeus container terminal started many years ago. According to Eurofound official site, the story started in 2006, when the former government (Nea Democratia) had tried to boost the liberalization of container port services, to increase the competitiveness of the port and to attract new investments from the private sector. In this sense, the former government tried to make an agreement with the COSCO Company. This group is one of the leader global container terminal operators and one of the very first (in terms of capacity) liner companies of the world. It has more than 80,000 employees from all over the world. If this agreement was becoming a reality, then the new operator would have the control of the entire container terminal and not only of Pier 2 & 3. Nevertheless, this agreement finally was not accepted by the European Commission[50], which demanded from the government to develop an open international tender. In the following years some global terminal operators showed their interest for this terminal. The most important company (besides COSCO), which presented an

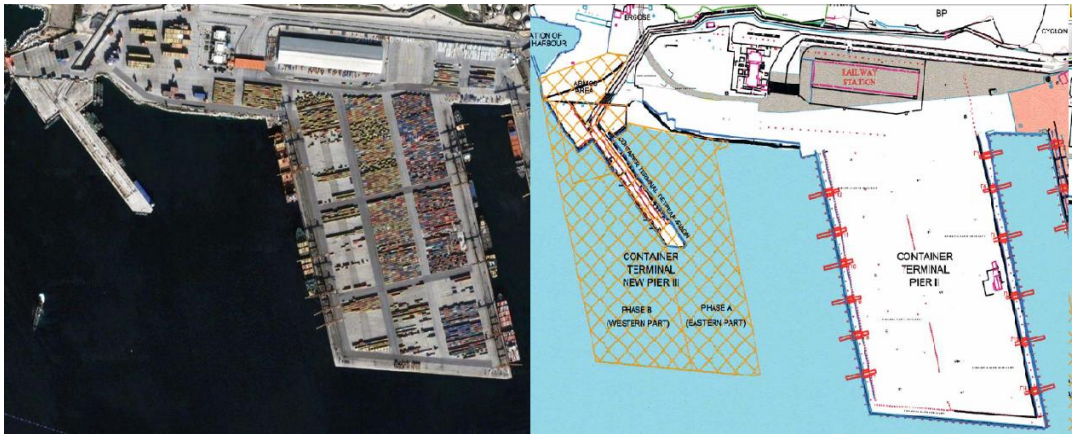
[50] According to the Eurofound official site.

interest was the HPH[51] (Hutchison Port Holdings). Both companies originate from China. Finally SEP SA (subsidiary company of COSCO Pacific Limited), achieved a concession agreement with the Greek Government and the port authority, based on which, the COSCO company fully operates Piers 2 & 3 (PCT container terminal). The SEP SA operates the terminal from October 1st 2009 and the concession is valid for 35 years (30 years plus 5 year extension possibility). Each year COSCO will have to pay a minimum fee of 3.4 billion for a period of 35 years. However, we do not have to forget the numerous strikes that took place during the last four years (from 2006). At the beginning the Association of Dockworkers of PPA and the Federation of Port Workers of Greece (OMYLE) were against the privatization of Piraeus container terminal claiming that the port of Piraeus could be profitable without the involvement of private operators and investments. The strikes of the aforementioned unions escalated when the COSCO started to operate the terminal on October 1st 2009 and for over a month those unions were against the concession for additional reasons (e.g. tax benefits of SEP SA). Nowadays the situation has calmed down and the PCT container terminal operates smoothly.

6.3.2.2 The investments in Piraeus Container Terminal (PCT)

SEP SA (COSCO) has a very promising plan for the development of the PCT terminal during the next years. As we will see in the following analysis, COSCO is planning to invest large amounts in infrastructure, superstructure and cargo handling equipment of PCT. In this way, the terminal will create the necessarily conditions for the provision of a variety of services to the customers. We can get an idea about the future picture of the terminal if we see the following figure.

Figure 6.3: Present map & future layup of PCT



source: Google maps & Piraeus port authority official site

[51] The parent company of HPH is the HWL (Hutchison Whampoa Limited) which has invested also in other areas such as the telecommunications and the property of hotels.

According to the official site of PCT, the investment plan of the Piraeus Container Terminal is the following:

- PCT is planning to increase the total surface of the terminal by building the Pier 3 (figure 6.3). The project is separated into two phases. In phase A, COSCO will build the eastern part of Pier 3, while in phase B the aforementioned company will build the western part of the Pier 3. This project will be finished until 2015 and the total surface of Pier 3 will reach 766.000 sqm.
- The Berth length will expand from the existing 1,487 m (in Pier 2[52]); into 2,087m when Pier 3 will be ready.
- Due to the construction of Pier 3, the number of available berths in the PCT will expand from 4 into 6.
- The depth of the new berths will be 16 m, the same depth as the one existing in the western part of the terminal. With this depth the container terminal can provide services even to the biggest mother ships (e.g. Emma Maersk). Only the eastern part of the terminal has a depth of 14 m, which is an appropriate depth not only for the feeder ships but also for bigger vessels (e.g. Post Panamax containerships).
- There will be an increase of the reefer capacity from 144 TEU's into 1,000 TEU's.
- Improvement of IT system. The PMIS (Port Management Information Systems) will be automated and in this way documents and critical information will be transferred faster and safer.
- COSCO will invest in 13 quay cranes until the middle of 2015. In combination with the increase of number of berths the terminal will be capable to serve more vessels. You can notice from the table below, the delivery schedule of the new cranes to the terminal.
- PCT will invest in 24 RTG's until the middle of 2015. This cargo handling equipment will be automated (at the beginning semi-automated). By the use of those cranes the terminal will achieve high density of stacking. At the table below, there is a presentation of the delivery schedule for the new cranes.
- Considering the straddle carriers and the tractors no serious investments will be undertaken. The number of those cargo handling equipments will stay stable and only few replacements will be done.

Table 6.2: Investments of PCT in Quay and Yard cranes

	October 2010	August 2011	July 2015
Existing Quay Crane	8	11	14
New Quay Crane	3	3	7
Total	**11**	**14**	**21**

	December 2010	June 2011	December 2011	July 2015
Existing RMG	0	6	12	18
New RMG	6	6	6	6
Total	**6**	**12**	**18**	**24**

source: PCT official site

[52] 787 m. in east quay and 700 m. in west quay

Concluding we have to mention that the main scope of the above investment plan is for the Piraeus container terminal to be capable (until 2015) to handle an annual throughput of 3,700,000 TEU's. More specifically, the capacity of Pier 2 will increase from 1,600,000 TEU's to 2,600,000 TEU's before 2014; while the capacity of Pier 3 will reach the number of 1,100,000 TEU's.

6.3.2.3 Individual strategies for the increase of the competitiveness in the Piraeus container terminal PCT.

Alongside the aforementioned strategic investments, which will shift the competitiveness of the terminal, we also indentified other individual strategies of the operator, which will influence positively the attractiveness of the terminal. These strategies include mainly two important elements; the labor structure of the terminal and the vertical integration of COSCO.

a) Labor structure

The president and CEO of COSCO, Captain Wei Jiafu[53], had promised that in the Piraeus container terminal all the employees will be Greek. This is true; however, the Piraeus container terminal and the Piraeus port authority container terminal have different structure. In the case of PCT, the majority of the people working in the terminal belong to the manpower of a private company which co-operates with COSCO. More specifically, Diakinisis Inc[54] is a private company which has signed a major agreement with COSCO. In this agreement, the employees of Diakinisis Inc have the responsibility of the loading and discharging procedures of ships, as well as the movement of containers within the terminal. This agreement mainly concerns the Pier 2. According to the official site of Diakinisis Inc, This cooperation started in March of 2010 for the probationary period of two months. In those months, according to Captain Wei Jaifu, the workers have shown high efficiency and accuracy. He also added, that up to a point, the increase in productivity[55] that the terminal presented during the first quarter of 2010 was the outcome of those employees.

b) Vertical integration of COSCO

COSCO is a group, which has invested in many areas related directly or indirectly to the shipping industry. Except from the fact that it is a leader liner company and a leader global terminal operator, it has also invested in railways. In the case of Greece, it is not for sure that the group will invest in this area, however as we will see in the next page, there is a strong possibility that this may actually happen. There is also the possibility that COSCO will invest in the shipbuilding & repair zone. Nevertheless, even if in the end COSCO doesn't invest in the railway or in the shipbuilding & repair zone (in Perama), the influence that it has in its own fleet will for sure increase the competitiveness of the terminal.

[53] According to the official site of Naftemporiki, the CEO of COSCO is also member of the Chinese Parliament, member of the Communist Party of China and Chairman of the Ethics Committee of the CCP.
[54] Parent company of Diakinisis Inc., is the Elgeka Group. This group has a turnover of € 318 million in 2009 and manpower of 1750 people
[55] The increase was 43% according to the official site of Naftemporiki.

For the conclusion of this part of our analysis, we would like to provide a statement by Cpt Wei Jiafu. According to the CEO of COSCO, the PCT terminal will become the “Gateway and transshipment hub in Greece, Mediterranean and Europe”. This will be achieved by the improvement of facilities, the acquisition of modern and automated equipment, the integrated upgraded technologies and the sophisticated-experienced labor force. All the previous elements, according to the aforementioned CEO, will increase the customer satisfaction and the productivity of the port.

6.4 Crucial parameters that influence the competitiveness of the Piraeus container terminals

In this part of our analysis we will provide some crucial parameters that will further improve the competitiveness of the Piraeus container terminals.

- According to Tongzon & Heng (2005), the private participation in a container terminal increases directly the efficicency of the port and indirectly its competitiveness. In our point of view, the privatization was a necessary step for the Piraeus competitiveness and development. Mr. Anomeritis also mentioned, in an interview ("Efoplistis" monthly magazine, September 2010) that: "no one competitive port in the world can live without the participation of a global operator". Considering the E. & C. Mediterranean region, we indentified that almost all the ports of our examination have been privatized for many years. One of the most positive developments of this privatization is the investments that COSCO has already started.

- The shift from monopoly to duopoly in the case of Piraeus harbor creates intra-port competition which benefits also the inter-port competition (Lengen and Pallis, 2004). This is a crucial element for the increase of the port’s competitiveness in the E. & C. Mediterranean region. Nevertheless, it is questionable how competitive will the environment become, between the two companies, due to the fact, that until the moment that we are writing this thesis, they are discussing the possibility to cooperate in the two terminals. According to the site of Naftemporiki, if such an agreement takes place, then it will have to be within the period in which the Chinese company will modernize the terminal (until 2015). During this period, overflow cargo that comes in one terminal will be forwarded to the other. In our point of view, this is a necessary agreement because, otherwise, the PCT will not be capable to serve all its customers and then many clients will select another place as a port of call.

- Another parameter what will influence positively the competitiveness of the port is the development of the Intermodal center of Attica at the Thriassion Pedion (in Elefsina). According to the official site of Naftemporiki, the Thriassion Pedion has a total surface of 590,000 sqm out of which 240,000 sqm. can be utilized for warehouses’ buildings and other similar uses. Like in the case of PCT, the aforementioned area will be privatized (for a time period of 40 years). At the moment that we are writing our thesis, an open international tender takes place and over 30 companies have shown their interest. Two of those companies are also COSCO and Piraeus port authority S.A. The tender has not finished yet

(August of 2010) but there is a strong possibility that COSCO, in cooperation with PPA, will win the tender. According to the official site of Efoplistis, this possibility exists due to the fact that the government prefers those two companies to co-operate and to develop the Intermodal center of Attica, because in that way the aforementioned companies will be capable to organize better and more efficiently their logistic activities and also because such a scenario will lead COSCO to forward much higher volumes of containers through Greece and not through other countries (e.g. Italy). Furthermore, If this possibility became a reality then the PPA and the COSCO company might cooperate in the provision of logistics services. Each port operator has created a logistics company. COSCO has the Cosco Logistic Co. while PPA has the Intermodal Transport and Logistics Company S.A. (Logistics PPA SA).

- As we have already proved, the connectivity of a port with other modes of transportation is a crucial element for the container terminal (Huang et al., 2003; Lirn et al., 2003; Tongzon & Heng, 2005; Cullinane et al., 2005; World Bank, 2007; Vlachos, 2007; Song & Yeo, 2004; Chang et al., 2008). Considering the Piraeus case, we proved that it lacks this important characteristic. In fact, it is the only harbour (together with the Marsaxlook [56]port) that does not have a rail connection. Another very crucial reason for the importance of realising the connection, is the direct link it will have (when it is ready) with the Thriassion Pedion. The rail line of 17 km. will connect both the container terminals with the Intermodal center of Attica. According to the site of PPA, the connection of this line costs approximately 143 million euros; OSE (Hellenic Railways Organization S.A.) is responsible for the construction and the operation of this line. According to the official sites of Naftemporiki and Efoplistis, OSE is one of the few remaining one-hundred-per-cent-public companies, burdened with extreme financial problems and due to this reason, the project has been delayed for many years. However, according to official statements by Mr. Anomeritis in Naftemporiki, most probably the line will be operational within the year 2011. Statements from government representatives, however, are supporting that the rail connection might be ready in three to four years. Due to the fact that OSE has delayed this project for many years, COSCO is having some serious conversations with the government in order to invest in the railway.

- Finally, another crucial parameter that influences the Piraeus competitiveness is the existence of good relations among the terminals with the shipping lines and the shippers. This relation will make more customers choose this port as a port of call and will increase the position of the port. It is obvious that the PCT terminal has “better” relations in comparison with the PPA terminal. This is due to the fact the COSCO (except from its own fleet) is a member of the CKYH alliance (or CKYH - the Green Alliance). This alliance includes also the K LINE, Hanjin Shipping and Yang Ming. Those companies are having close relationships with COSCO and increasingly more intensive activities with the Piraeus container terminal. Considering the PPA terminal, we can say that it has

[56] Comparatively with the port of Piraeus, the Marsaxlokk port don't need so much the rail connection because (according to our literature review in chapter 4) it is more a transshipment port and also because it is a small size inland (with small surface).

traditionally very strong relations with the MSC (Mediterranean Shipping Company). Until a few years ago, this liner company was responsible for almost half the TEU volume of the Piraeus transshipment activities. Nevertheless, during the last years, MSC decreased its activities in the aforementioned port, due to the fact that the continuous strikes decreased its attractiveness (according to the official site of Neftemporiki). Nowadays, the MSC invests again in the Port of Piraeus, but this time it does not have any special agreement as it used to have before the privatization of the port (according to the interview that we had with Professor Karli).

6.5 Positive influence of private participation in the economic environment of Greece

At this point we consider it very important to broadly analyze the benefits of private participation in the Greek environment. These benefits will not directly increase the competitiveness of the Piraeus port, but indirectly and in long term, they can influence the attractiveness of the port. COSCO has invested in a very strategic port and its investments, most probably, will not stop there. This company is willing to invest in many different businesses, such as the railway, the logistics (Intermodal center of Attica), the shipbuilding and repair zone of Perama, as well as in tourist activities. Behind the COSCO company China is hiding and the investments of such a power in our country will help us get out of the impasse of the financial crisis much faster. Besides the revenues that we already have from the concession agreement (approximately 35 million per annum) many opportunities could be created. In that way, the Chinese capital will increase the investments in Greece and the economy will change for the better. Finally, new job opportunities will be created and the percentage of unemployment could decrease.

Chapter 7: Conclusions and recommendations

7.1 Conclusions

The eastern and central Mediterranean container terminals can be characterized as ports with low intra-port competition and very strong participation of the global container terminal operators. More analytically, only in three cases (Port Said, Izmir and Piraeus ports) we indentify this type of competition; while in seven from the nine ports of our examination we found that at least one global container terminal operator controls one terminal (or more). As consider the cargo handling equipment of the examinee ports, we recognize that each terminal has its own complicated way of operation and so it is extremely difficult to recognize specific trends. Only two trends we can identify and those are the increasingly operation and investment in Super Post Panamax quay cranes and the preference of using high density staking with RMG's or/and RTG's.

By using the analysis of variance (one-way anova) we identify the inter-port competition among the E. & C. Mediterranean ports. Specifically, we group the nine ports into "homogenous subsets". In the first subset we find the ports of Ashdod, Taranto, Izmir, Damietta, Haifa and Piraeus (with average cargo volumes from 698 to 1,202 thousand TEUs). The second subset includes the ports of Damietta, Haifa, Piraeus and Marsaxlokk (with mean traffic volumes ranging from 1,070 to 1,745 thousand TEUs). The third subset includes the port of Marsaxlokk together with Port Said (with average cargo volumes of 1,745 and 2,120 thousand TEUs respectively). Finally, we infer that Gioia Tauro port is a subset by itself - subset 4 - with average traffic of 3,182 thousand TEUs. The fact that some ports appear in more than one subsets shows that there are not significant differences in the traffic volumes of containers among them. Consequently, competition among them is expected to be more intense.

In another level, by using the benchmarking technique we measured the inter-port competition in the defined market for the year 2009. This model includes 18 variables which had previously proved their influence on the competitiveness of a container port. Without doubt, those elements are not the only criteria that influence the competitiveness of a port, but still were the only elements that could be collected in the limited time available.

Through this methodology, we concluded that the Gioia Tauro is the leader port in the E. & C. Mediterranean region, while the port of Piraeus ranks lower than the average port. The reason for this classification stems from the fact that Piraeus falls short in the following characteristics: It was operational less than 365 days in 2009, it has no connection with the railway network, it has smaller capacity of reefer points, exhibits lower productivity, has small container terminal surface, limited storage capacity in TEUs and finally, limited number of berths. These conclusions derived from the comparison of Piraeus with the leader port of Gioia Tauro.

However it seems that in the following years and especially until the 2015, all the aforementioned deficiencies will not exist due to the fact that various investments will take place in each container terminal of the Piraeus port. In that way, the competitiveness of the Piraeus port will increase.

Furthermore, due to the fact that a global container terminal operator controls nowadays one of the two container terminals, it become easily understandable that the competitiveness of the port will most probably increase even more in the future. One very crucial reason is that COSCO can attract except from its own vessels also the vessels of the alliance in which belongs. Another factor is that due to the vertical integration of this company and the investment plants that it has for Greece, COSCO will most probably capable to provide a variety of services in his clients and in that way the total attractiveness of the port could increase.

Finally, due to the change of the Greek environment with major investment are taking place within the next years, in the area of transport and logistics the attractiveness of the Piraeus port should most probably increase. These investments mainly include the rail connection and the Intermodal center of Attica. Ofcourse the possible involvement of COSCO in those projects will accelerate the processes.

So, concluding our investigation we can say that all the aforementioned factors will increase positively the competitiveness of the Piraeus container port and will develop a stronger economy in Greece. Certainly, this shift will take some time but it will eventually happen during the following years.

7.2 Research Limitations

In this study we did not take under consideration some very crucial elements which influence the container terminal competitiveness. More specifically, those factors are:

- The sophisticated, skilled and stable labour in a container terminal influences dramatically the competitiveness of a port (Huang et al., 2003; Cullinane et al., 2004; Tongzon & Heng, 2005; Yeo et al., 2008; Grosso & Monteiro, 2008). For example, a sophisticated labour can increase the productivity of a port and in that way to increase the competitiveness of the terminal. Furthermore, if the labour of a port does not have stability due to strikes (e.g. Port of Piraeus) or other reasons, then the image of the port changes negatively and the competitiveness of the port is decreasing. Unfortunately, we could not include this element in our analysis due to the fact that it was very difficult, in most cases, to determine if the labour is sophisticated or not in a container terminal.

- Another factor that we could not take under consideration in our study was the cost of a ship related to port dues and to port services (pilotage, mooring, towage etc.). These costs influence dramatically the competitiveness of a port (Huang et al., 2003; Song & Yeo, 2004; Tongzon & Heng, 2005; Cullinane et al., 2005; World Bank, 2007; Vlachos, 2007; Grosso & Monteiro, 2008; Chang et al., 2008; Pallis & Vitsounis, 2009). Unfortunatly, these costs are not published by the port authorities or by any other private company and so, we left them out of the examination. For the same reason, we did not include in our thesis the handling, storage and transfer costs of the ship; especially in this case, their effort to keep those kinds of data secret, proved extremely strong,

due to the fact that the pricing policy varies from client to client and so, a publication of such a data would lead to serious problems in the closing of agreements with the clients (bigger or smaller).

- In our study, we tried to use the number of calls as a variable, due to the importance that calls have to port's competitiveness (Baird, 2000; Itoh & Doi, 2002; Huang et al., 2003; Lirn et al., 2003; Yeo et al., 2008). However, no port authority or private terminal operator was willing to provide us with this kind of information, so we left it out of examination.

- Almost the same thing happened with the transhipment information that we were looking. Only one port authority provided us with the update transhipment data of 2009; all the others (except from Piraeus port) denied to share with us any numbers on volumes or ratios. In most of the port authorities' and private operations' official sites, no serious data is published[57] and even in a few cases that this happened, the information was out-update. Finally, the containerizations international yearbooks (of 2009-2010) do not provide such type of information in most of the cases (at least for the ports of our selection). So, since we did not obtain update data about this competitive variable, we had to leave it out of examination.

- Concerning the efficiency of the handling (and not only) services in a terminal, we do not focus on this factor, even if it is an important feature for the competitiveness of a container port (Huang et al., 2003; Tongzon & Heng, 2005; World Bank, 2007; Vlachos, 2007). The reason is that in order to measure efficiency, we should use more appropriate methodology such us the Data Envelopment Analysis (DEA) which was used on a variety of selected ports, by Baris Demirel.

- Finally, regarding the connectivity of a terminal with other modes of transportation, we know that it is a very crucial factor for the competitiveness of a container port (Huang et al., 2003; Lirn et al., 2003; Tongzon & Heng, 2005; Cullinane et al., 2005; World Bank, 2007; Vlachos, 2007; Song & Yeo, 2004; Chang et al., 2008). We have included this variable in chapter 5, where we examined the existence of rail connection with the container port. However, an indepth analysis in this element requires a very systematic and complicated collection of data, which was impossible due to lack of information provided to us. For the same reason, we decided not analyse the connectivity of the ports with other modes of transportation.

7.3 Recommendations for further research

The benchmarking methodology for the measurement of the port competition is a quite new approach of this technique. With this perspective, it was implemented by Dr. Michalopoulos for the first time, in 2006. However, the first English publication of this methodology became available only in the middle 2008. Thus, it is not so

[57] Except for the Piraeus port which has an updated site.

popular yet; nevertheless, it has the ability to become a quite attractive one for the measurement of the port competition in a defined market, especially if some things improved. More precisely, in our point of view, two things can be improved.

1. The most important thing that can be improved is the introduction of weights for the selected variables. In this way, the methodology will become more objective. However, in order to import weights, it is essential that data exist for each variable and for a number of years. Then, we would be capable of applying the method of fixed weights in order to have a satisfactory outcome. In our case, we couldn't import any weights because of lack of variable data (for many years) and due to the limited time available for the elaboration of our thesis.

2. Due to the flexibility of the methodology, more variables could be taken into account. For example, if we had any data available about the number of calls of each port, these could be incorporated in the model. Nevertheless, due to the lack of this type of information and because we didn't have the necessary time we used only the selected 18 variables in our analysis**.**

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www.portdigioiatauro.it

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Appendix A: Throughput and growth rates of the E. & C. Mediterranean ports for the years 2003-2009

PORT	TRAFFIC VOLUMES 2009 (000 TEU's)	TRAFFIC VOLUMES 2008 (000 TEU's)	TRAFFIC VOLUMES 2007 (000 TEU's)	TRAFFIC VOLUMES 2006 (000 TEU's)	TRAFFIC VOLUMES 2005 (000 TEU's)	TRAFFIC VOLUMES 2004 (000 TEU's)	TRAFFIC VOLUMES 2003 (000 TEU's)	% CHANGE 2007-2008	% CHANGE 2006-2007	% CHANGE 2005-2006	% CHANGE 2004-2005	% CHANGE 2003-2004
GIOIA TAURO	2.855	3.467	3.445	2.938	3.160	3.261	3.149	1	17	-7	-3	4
PORT SAID	3.258	3.202	2.820	2.691	1.340	869	659	14	5	101	54	32
MARSAXLOKK	2.330	2.334	1.901	1.485	1.400	1.461	1.305	23	28	6	-4	12
PIRAEUS	665	434	1.373	1.403	1.395	1.542	1.605	-68	-2	1	-10	-4
HAIFA	1.140	1.262	1.149	1.070	1.123	1.043	1.069	10	7	-5	8	-2
DAMIETTA	1.264	1.142	978	906	1.130	1.115	955	17	8	-20	1	17
IZMIR	725	895	892	848	784	805	670	0	5	8	-3	20
TARANTO	741	787	756	892	717	763	658	4	-15	24	-6	16
ASHDOD	893	828	808	692	586	545	531	2	17	18	8	3

source: Containerization International Yearbook 2009-2010 & various sites of port authorities and terminal operators

Appendix B: Tukey's Post Hoc Test

Multiple Comparisons

TEU's

Tukey HSD

(I) Port	(J) Port	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
GIOIA TAURO	PORT SAID	1062.286*	237.777	.001	294.09	1830.48
	MARSAXLOKK	1437.000*	237.777	.000	668.80	2205.20
	PIRAEUS	1979.714*	237.777	.000	1211.52	2747.91
	HAIFA	2059.857*	237.777	.000	1291.66	2828.05
	DAMIETTA	2112.143*	237.777	.000	1343.95	2880.34
	IZMIR	2379.503*	237.777	.000	1611.31	3147.70
	TARANTO	2422.943*	237.777	.000	1654.75	3191.14
	ASHDOD	2484.571*	237.777	.000	1716.38	3252.77
PORT SAID	GIOIA TAURO	-1062.286*	237.777	.001	-1830.48	-294.09
	MARSAXLOKK	374.714	237.777	.813	-393.48	1142.91
	PIRAEUS	917.429*	237.777	.009	149.23	1685.62
	HAIFA	997.571*	237.777	.003	229.38	1765.77
	DAMIETTA	1049.857*	237.777	.002	281.66	1818.05
	IZMIR	1317.218*	237.777	.000	549.02	2085.41
	TARANTO	1360.657*	237.777	.000	592.46	2128.85

	ASHDOD	1422.286*	237.777	.000	654.09	2190.48
MARSAXLOKK	GIOIA TAURO	-1437.000*	237.777	.000	-2205.20	-668.80
	PORT SAID	-374.714	237.777	.813	-1142.91	393.48
	PIRAEUS	542.714	237.777	.371	-225.48	1310.91
	HAIFA	622.857	237.777	.203	-145.34	1391.05
	DAMIETTA	675.143	237.777	.128	-93.05	1443.34
	IZMIR	942.503*	237.777	.006	174.31	1710.70
	TARANTO	985.943*	237.777	.004	217.75	1754.14
	ASHDOD	1047.571*	237.777	.002	279.38	1815.77
PIRAEUS	GIOIA TAURO	-1979.714*	237.777	.000	-2747.91	-1211.52
	PORT SAID	-917.429*	237.777	.009	-1685.62	-149.23
	MARSAXLOKK	-542.714	237.777	.371	-1310.91	225.48
	HAIFA	80.143	237.777	1.000	-688.05	848.34
	DAMIETTA	132.429	237.777	1.000	-635.77	900.62
	IZMIR	399.789	237.777	.755	-368.41	1167.99
	TARANTO	443.229	237.777	.640	-324.97	1211.42
	ASHDOD	504.857	237.777	.469	-263.34	1273.05
HAIFA	GIOIA TAURO	-2059.857*	237.777	.000	-2828.05	-1291.66
	PORT SAID	-997.571*	237.777	.003	-1765.77	-229.38
	MARSAXLOKK	-622.857	237.777	.203	-1391.05	145.34
	PIRAEUS	-80.143	237.777	1.000	-848.34	688.05

	DAMIETTA	52.286	237.777	1.000	-715.91	820.48
	IZMIR	319.646	237.777	.913	-448.55	1087.84
	TARANTO	363.086	237.777	.838	-405.11	1131.28
	ASHDOD	424.714	237.777	.691	-343.48	1192.91
DAMIETTA	GIOIA TAURO	-2112.143*	237.777	.000	-2880.34	-1343.95
	PORT SAID	-1049.857*	237.777	.002	-1818.05	-281.66
	MARSAXLOKK	-675.143	237.777	.128	-1443.34	93.05
	PIRAEUS	-132.429	237.777	1.000	-900.62	635.77
	HAIFA	-52.286	237.777	1.000	-820.48	715.91
	IZMIR	267.361	237.777	.968	-500.84	1035.56
	TARANTO	310.800	237.777	.925	-457.40	1079.00
	ASHDOD	372.429	237.777	.818	-395.77	1140.62
IZMIR	GIOIA TAURO	-2379.503*	237.777	.000	-3147.70	-1611.31
	PORT SAID	-1317.218*	237.777	.000	-2085.41	-549.02
	MARSAXLOKK	-942.503*	237.777	.006	-1710.70	-174.31
	PIRAEUS	-399.789	237.777	.755	-1167.99	368.41
	HAIFA	-319.646	237.777	.913	-1087.84	448.55
	DAMIETTA	-267.361	237.777	.968	-1035.56	500.84
	TARANTO	43.439	237.777	1.000	-724.76	811.64
	ASHDOD	105.068	237.777	1.000	-663.13	873.26
TARANTO	GIOIA TAURO	-2422.943*	237.777	.000	-3191.14	-1654.75

	PORT SAID	-1360.657*	237.777	.000	-2128.85	-592.46
	MARSAXLOKK	-985.943*	237.777	.004	-1754.14	-217.75
	PIRAEUS	-443.229	237.777	.640	-1211.42	324.97
	HAIFA	-363.086	237.777	.838	-1131.28	405.11
	DAMIETTA	-310.800	237.777	.925	-1079.00	457.40
	IZMIR	-43.439	237.777	1.000	-811.64	724.76
	ASHDOD	61.629	237.777	1.000	-706.57	829.82
ASHDOD	GIOIA TAURO	-2484.571*	237.777	.000	-3252.77	-1716.38
	PORT SAID	-1422.286*	237.777	.000	-2190.48	-654.09
	MARSAXLOKK	-1047.571*	237.777	.002	-1815.77	-279.38
	PIRAEUS	-504.857	237.777	.469	-1273.05	263.34
	HAIFA	-424.714	237.777	.691	-1192.91	343.48
	DAMIETTA	-372.429	237.777	.818	-1140.62	395.77
	IZMIR	-105.068	237.777	1.000	-873.26	663.13
	TARANTO	-61.629	237.777	1.000	-829.82	706.57

*. The mean difference is significant at the 0.05 level.

Appendix C: Tukey's Homogeneous Subsets

TEU's

Tukey HSD

Port	N	Subset for alpha = 0.05			
		1	2	3	4
ASHDOD	7	697.57			
TARANTO	7	759.20			
IZMIR	7	802.64			
DAMIETTA	7	1070.00	1070.00		
HAIFA	7	1122.29	1122.29		
PIRAEUS	7	1202.43	1202.43		
MARSAXLOKK	7		1745.14	1745.14	
PORT SAID	7			2119.86	
GIOIA TAURO	7				3182.14
Sig.		.469	.128	.813	1.000

Means for groups in homogeneous subsets are displayed.

Appendix D: Correlation Analysis

Descriptive Statistics

	N	Minimum	Maximum	Sum	Mean	Std. Deviation
COMPETITIVENESS DEGREE	9	7,52	18,64	100,00	11,1111	4,34459
BEST SCORE	9	27,78	77,78	427,78	47,5309	14,19418
Valid N (listwise)	9					

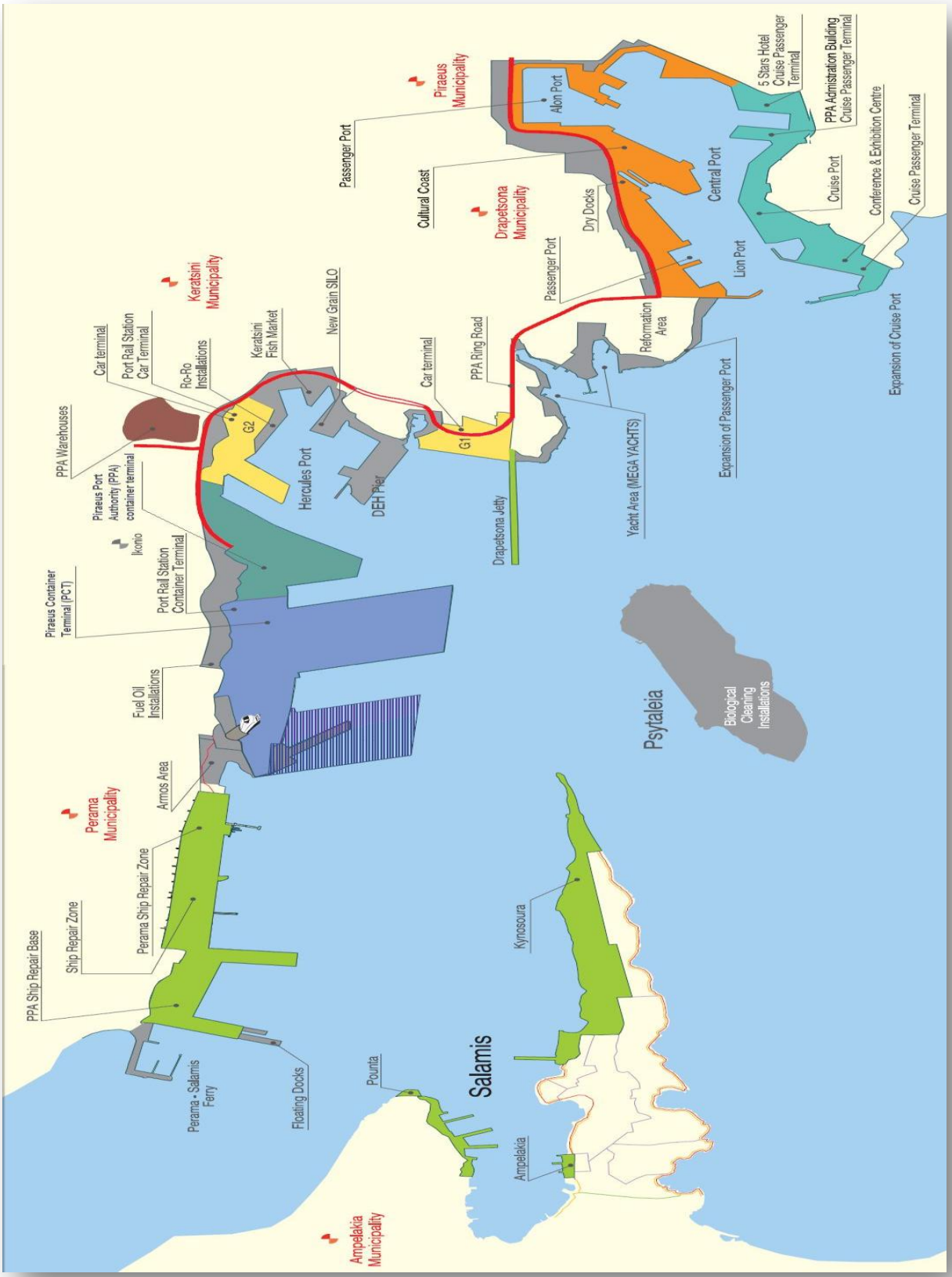
Correlations

		COMPETITIVENESS DEGREE	BEST SCORE
COMPETITIVENESS DEGREE	Pearson Correlation	1,000	,890**
	Sig. (2-tailed)		,001
	N	9,000	9
BEST SCORE	Pearson Correlation	,890**	1,000
	Sig. (2-tailed)	,001	
	N	9	9,000

**. Correlation is significant at the 0.01 level (2-tailed).

Appendix E: The map[58] of Piraeus Port

source: PPA



[58] Includes also areas that will develop from various investment plans

Appendix F: Topography of Piraeus Port Authority Container terminal

source: PPA