EVALUATING THE NEED FOR AND CHOICE OF A SEAPORT HUB IN THE EASTERN MEDITERRANEAN REGION BASED ON THE MERITS OF INTERNATIONAL LOGISTICS - SUPPLY CHAIN

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This thesis is dedicated to Panos Aristofanous, a loving friend whose memory will always be with me.

Abstract

A trend emerged during the mid 1990s, where Liner operators considered a new strategy for serving the Eastern Mediterranean countries from the Far East region: the choice being via a centrally located seaport hub instead of via Eastern Mediterranean seaport hubs. The author raised several questions in relation to this strategy since shippers experienced prolonged transit time delays. Feedback from Liner operators was minimal, so the author decided to view the matter on a more global basis, and more specifically, from the international logistics supply chain with focus on lead time. A supply chain links all activities of cargoes from source to user, that is, from the raw material until goods are delivered to the end customer. Using this as a basis the objective of this thesis is to evaluate the need for and choice of a seaport hub in the Eastern Mediterranean for cargoes originating from the Far East destined to the Eastern Mediterranean.

Initially the author proposes the segmentation of the Mediterranean in three distinct peripheral regions, namely, the West, the Central and the East. Focus is given on 6 potential seaport hubs in the Eastern Mediterranean, namely, Damietta, Piraeus, Limassol, Port Said, Haifa and Alexandria, and 3 seaports in the Central Mediterranean, namely, Gioia Tauro, Marsaxlokk and Taranto. A description of these seaports characteristics and facilities was the first step undertaken in order to describe the infrastructure and operational status. This was reinforced by a 10 day fieldtrip to several of these seaports.

A survey analysis on the Eastern Mediterranean hub candidates was carried out through a questionnaire. The survey analysis has revealed the suitable seaport hubs in the Eastern

Mediterranean namely, Piraeus, Limassol, Port Said and Damietta, being the most suitable. Furthermore for each of the candidate seaports the seaport hub criteria are identified. Extending these findings the seaports hub criteria are ranked in terms of importance and significant differences are highlighted.

Based on the results of the survey analysis, the author produced a simulation model to measure the potential cargo transit times of these hubs compared to centrally located hubs. More specifically, the concept of Average Cargo Transit Time (ACTT) is introduced by the author and used as a new alternative approach of comparison between Centrally located seaport hubs versus the most suitable Eastern Mediterranean seaport hubs. Furthermore, the simulation has allowed for a "what if" analysis through alterations of the quantities of parametric variables, such as, vessel speed, volume of cargo, loading/discharging rates, etc.

The simulation model produces four important findings: Firstly, it reveals that the Eastern Mediterranean seaport hubs offer significantly lower ACTT compare to Centrally located seaport hubs. Secondly, comparing the biggest seaport hub at the Central of the Mediterranean (Gioia Tauro) with the most usuitable seaport hub of the Eastern Mediterranean (Damietta) a difference of approximately 7 days in ACTT exists. Thirdly, a "what if" analysis highlighted the sensitive and robust features of the ACTT, based on the parametric variables used in the simulation. Fourthly, two realistic scenarios proposed by the author validate that ACTT can be reduced substantially.

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ABBREVIATIONS

- CMA: Compagnie Maritime d'Affrètement (CMA) and Compagnie Générale Maritime (CGM),
- Contship: Contship Container Lines Ltd
- COSCO: China Ocean Shipping (Group) Company
- DSR: DSR Senator Lines GmbH
- Evergreen: Evergreen Marine Corporation (Taiwan) Ltd
- Hapag-Lloyd: Hapag-Lloyd Container Linie GmbH
- MISC: Malaysia International Shipping Corp Berhad
- MSC: Mediterranean Shipping Company SA
- Nedlloyd: P&O Nedlloyd Lines
- Norasia: Norasia Lines
- Sarlis: Sarlis Container Services SA
- Yang Ming: Yang Ming Marine Transport Corp
- UASC: United Arab Shipping Co
- ZIM: ZIM Israel Navigation Co Ltd
- OOCL: Orient Overseas Container Line Ltd
- CSAV:
- K-Line: Kawasaki Kinkai Kisen Kaisha Ltd
- Hanjin: Hanjin Shipping Co Ltd
- APL: American President Lines Ltd
- Hyundai: Hyundai Merchant Marine Co Ltd
- MOL: Mitsui – OSK Lines Ltd
- NYK: Nippon Yusen Kaisha

INDIVIDUALLY OPERATING SUBSIDIARIES OR SISTER COMPANIES IN 2004

- China Shipping: Shanghai Puhai
- CMA CGM: ANL, Cagema, FAS, McAndrews, Ybarra
- CP Ships: ANZDL, CanMar, Cast, Contship, Italia, Lykes Lines, TMM Lines
- CSAV: Hansa Star, Libra, Montemar, Norasia
- Delmas: OTAL, Setramar, Sudcargos (50%)
- Evergreen: Hatsu, Lloyd Triestino
- Hamburg Süd: Aliança, Ellerman
- Hanjin: Senator Lines
- Maersk Sealand: MCC, Seaportlink, Safmarine, UACL (ex Unifeeder)
- NYK: T.S.K. Line
- P&O Nedlloyd: Farrell, Mercosul Line, P&O Swire
- PIL (Pacific International Lines): Advance Container Lines, Pacific Eagle
- Wan Hai: Interasia Lines

1. INTRODUCTION

The aim of the study is to investigate whether, in the case of cargoes originating from the Far East (via Suez) destined to the Eastern Mediterranean region and currently, some, transhipping at a centrally located seaport hub (Gioia Tauro, Marsaxlokk, Taranto), valuable transit time may be saved if an Eastern Mediterranean hub is chosen instead. Furthermore, the study aims to identify:

1) What are the alternative hub region options in the Mediterranean?
2) Which are the alternative candidate seaport hubs?
3) Which are the most important seaport hub criteria, considered by Liner operators and their respective ranking?
4) Which are the most suitable seaport hubs and their suitability ranking?
5) What is the transit time offered via seaport hubs in the Central and alternatively via Eastern Mediterranean seaport hubs?
6) Which seaport hub criteria, and to what extent, is transit time sensitive or robust. (What if analysis).
7) To what extent can further reductions in transit time be achieved through the choice of a suitably located seaport hub?

An approach to this thesis would be to solely focus on the Liner operators being considered as the sole decision makers. However, two components of this approach are regarded as relatively weak. In the current business environment, new orientations and competitive situations require collaboration amongst all participants, as well as, the establishment of common goals through integration. Second, the Liner operator's dependence on cargoes (derived demand) and on market forces demands a more global approach.

On the other hand, the international logistics supply chain approach can better provide the foundation of this research based on the following points.

1. It is globally acknowledged that in the today's era radical changes in business have taken place. The supply chain is part of the new trend, a new management system linking product and material flow from source to final customer with the objective of adding value and satisfying customer needs. A 1996 survey by Deloitte and Touche in Canada revealed that 98 percent of respondents believed that logistics and supply chain is critical to any organization, Waters (1999) pp 3-4.
2. Liner operators are considered part of a supply chain.
3. Lead time saving is a powerful strategy tool for any organization forming either a lean supply chain or a agile supply chain, see Section 2.3.
4. The Council of Logistics Management has done a major study regarding the improvement of logistics functions, Lambert et al. (1993) p 131. The study revealed that transportation carriers play a vital role in the overall quality of the logistics supply chain and that shippers set many criteria in order to evaluate and select

carriers. However, the findings of Brooks (2000) indicated that transit time is considered as a top rated criterion.

These are some of the points discussed in Chapter 2 together with an overall explanation of the logistics supply chain and its importance in the modern business environment. Furthermore, Chapter 2 attempts to relate these topics with the Liner operators' decisions with emphasis on transit time.

Chapter 3 focuses on the Liner industry where, progressively over the last 10 years, a remarkable revolution has taken place. This forms an extension of the new containerization era. Ships with a capacity in the region of 8,500 containers bear witness to this current evolution, with their aim being to achieve maximum economies of scale. As a consequence, almost all Liner operators today are consolidating their status through mergers, acquisitions, etc., aiming for further reduction of cost. Motherships are extremely expensive to build and operate, thus idle time must be as little as possible including stoppages at the seaport hubs whilst loading/discharging. At the same time, Liner operators have begun to invest more in transhipment strategies by calling at even fewer seaports hubs. It is noted that world container transhipment throughput during 2001 was estimated to be 54 million TEU, representing 22% of world seaport demand, Ocean Shipping Consultants (2003).

An extension of these accelerated developments is the seaport industry, which is also equally capital intensive. Seaports today form an integral part of the logistics supply chain. The aim of seaports is to provide added value through operational excellence and cost leadership

towards all users. One development of this era is the involvement of Liner operators in the terminal control business through vertical integration. The idea stems from the shift towards bigger ships driving Liner operators to acquire more control by integrating stevedoring (port handling operations including mother/feeder ships) through the transhipment strategy. A further rapid development is the Terminal Management Business that makes competition amongst seaport hubs even greater today. It is considered natural on the part of seaport authorities to offer tailor-made packages, substantially low rates and flexibility. This sequential trend of pooling resources (e.g. coalitions, mergers, acquisitions) aims to reduce cost, acquire more cargo volumes and offer overall better service including less transit time to customers, with the ultimate objective being to increase profitability. Otherwise, this derived demand industry may not be regarded as viable for some operators.

The author attempts to view the actions of Liner operators, the seaport industry and shippers/receivers within a common objective framework in the overall supply chain. The question to be answered in the chapters that follow is whether Liner operators in their decisions to service the Eastern Mediterranean region via a centrally located hub (cargoes originating from the Far East) offer a viable transit time in comparison to other Mediterranean hubs, if there are any.

An investigation of the Mediterranean market follows, (Chapter 4) in order to describe Central and Eastern Mediterranean seaport status as well as to highlight the market potential and overall growth of the Eastern Mediterranean region. However, the author does not make a separate comparison between Central and Eastern Mediterranean seaports in terms of

facilities, characteristics and overall infrastructure although the study provides a description of the seaports and shows that competition exists among the two regions. Nevertheless, the seaports infrastructure does not alter transit time significantly as will be indicated in Chapter 7. Furthermore, shippers and receivers will not take into consideration the fact that a seaport is extremely capable and possibly highly ranked, if their goods suffer extensive transit time delay. Even where freights overall decline, this may not be a justification for a less viable service. However, freights between the two regions are charged at almost the same rates from the Far East, either through transhipment in the East or in the Central Mediterranean[1].

Centrally located hubs, namely, Gioia Tauro (Italy), Marsaxlokk (Malta) and Taranto (Italy), being in competition with Eastern Mediterranean seaports, act as transhipment hubs for cargoes originating from the Far East destined to the Eastern Mediterranean. This took place, mainly, between the years 1996 and 2000.

The characteristics and facilities of Gioia Tauro (see Section 4.2.1) seem to rank top though the large cargo volumes (2.6 million containers) during 2002 caused periodic congestion problems. Eastern Mediterranean seaports show substantial container seaport throughput increase between 1995 and 2001 (63%); and in 2002 generated approximately 7 million TEU of which 1.5 million containers per annum from the Far East[2], Ocean Shipping Consultants (2003) p 171-176.

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[1] Personal consultation with Hapag-Lloyd and Yang Ming.
[2] Personal consultation with GAP Vassilopoulos Ltd.

The Eastern Mediterranean countries' GDP rates are considered relatively high with a potential of future growth. Six major seaports in the Eastern Mediterranean namely Piraeus, Alexandria, Damietta, Port Said, Limassol and Haifa handled 100% of the total transit cargo (containers) during 1996. Given that these seaports possess at least medium to high hub role potential Hunter (1996) the present study will concentrate on them as the most likely hub candidates to be evaluated in the Eastern Mediterranean. It is noted that during 2003 these seaports are still considered the major seaports in the region. Ocean Shipping Consultants (2003) p 201

The author takes the view that the Eastern Mediterranean seaports market needs to be seen globally in terms of volume growth potential. Furthermore, the Far East market may be forecasted as prosperous, especially mainland China. Evidently the Far East shippers that export to the Eastern Mediterranean countries are in competition with other origins around the globe and would request, among other things, the best transit times.

Currently, (where centrally located seaports act as hubs) Far East containers destined to the Eastern Mediterranean cover an additional 2000 miles approximately from Suez to Gioia Tauro and from Gioia Tauro to the Eastern Mediterranean. It is obvious that transit time is highly dependent on the transit distance covered. Since all the cargo that is destined to the Eastern Mediterranean is transhipped, the average cargo transit time may be reduced if an Eastern Mediterranean seaport hub is chosen instead. Furthermore, centrally located hubs have various problems including congestion. In the last few years (2001-2003), some shipping lines shifted from centrally located hubs towards the Eastern Mediterranean seaports

of Piraeus, Damietta and Port Said. The additional benefits that Eastern Mediterranean seaports may offer to Far East shippers are also identified.

In Chapter 5, the author attempts to address an important aim of the study, namely, the choice of a seaport hub in the Eastern Mediterranean amongst the available candidates. The idea is to compare the different seaports in terms of their ability to successfully meet certain criteria. Given that the Liner operators are the primary decision makers, the author considered it necessary to conduct an investigation through a survey analysis. A questionnaire was forwarded to specific Liner operators. The author also visited almost all major candidate seaports through a field trip of 10 days. This assisted in confirming some of the Liner operators' feedback. In the questionnaire, 14 hub choice criteria were set. These were taken from Bascombe (1995), and Liner operators were required to rate: (i) the rate of importance of each criterion, and (ii) each of the candidate seaports on the specific criterion.

The analysis of the questionnaire data, Chapter 6, reveals that four seaports are more suitable seaport hub candidates, namely Damietta, Piraeus, Limassol and Port Said. An additional method is employed (confidence intervals) to show whether significant differences exist in the importance of the various criteria (if a specific criterion ranks higher than another it reveals the extent of this difference and whether it overlaps or not; if two criteria do not overlap, a significant difference may exist in terms of importance).

The findings reveal the strengths and weaknesses of each hub candidate, as well as, the top rated seaport hub. The most important criteria appear to be local cargo volume and feedering connection though other criteria are also relevant. Local cargo is rated 'high' since the volume of containers is associated with lower costs for the Liner operator (saving one handling move compared to transhipment through other seaport) and because it decreases the average cargo transit time (see Chapter 7). However, the author proposes an additional approach concerning hub popularity, as compared to Zohil & Prijon (1999).

Given that suitable seaport hubs exist in the Eastern Mediterranean, a simulation model is constructed in Chapter 7 that considers the cargo transportation procedure from the departure seaport (Far East) until the final destination seaport (Eastern Mediterranean). The simulation makes use of a series of parameters such as the seaports' operational and geographical status, as well as, feeder schedules, speed of vessels, turnaround times, cargo volumes, distance, destinations, etc. This way, the model may be adapted to alternative hub choices (Eastern versus Central) and allow for the attainment of comparable transit times. The Eastern Mediterranean seaport hubs under investigation (Damietta, Piraeus and Limassol) are compared with the seaport hub, of Gioia Tauro. The simulation model allows for a "what if" analysis, through different choices of values of the parameters involved. The results confirm that shippers, receivers and consignees may acquire the benefits of a more competitive supply chain based on significantly reduced transit time.

The author does not wish to specifically evaluate the importance of the number of days saved since this topic has been covered in Chapter 2. The author considers that a crucial point raised

in Chapter 2 refers to the shippers' priority expectation from Liner operators: to offer the least possible transit times. A further investigation leading to new research may cover this specific topic in relation to the costs and benefits of transit time saving for shippers originating from the Far East and destined to the Eastern Mediterranean countries.

2. THE ESSENCE OF LOGISTICS

In this chapter the author emphasizes the importance of international logistics supply chain[3] as part of a new trend, a new management system linking product material flow from source to final user. This forms the basis of the thesis, since all participants in the supply chain, to a certain extent including Liner operators, are interdependent. Vital issues that form an integral part of a supply chain, i.e. collaboration, inventory, customer service, shippers criteria, lead time, as well as the integration of transport in the supply chain are discussed, in an effort to correlate the service offered from Liner operators (Cargoes originating from the Far East destined to the Eastern Mediterranean) with the element of transit time. As worldwide markets become more service sensitive the element of lead time compression is considered crucial either forming a lean supply chain, a agile supply chain or a leagile supply chain. The author will attempt to demonstrate that Liner operators should contribute towards this notion by offering less possible transit times, especially where Shippers rank the criterion of transit time as crucial and occasionally rate it as top. A practical example to be illustrated is the St Laurence Coordinated Services Brooks (2000), where, transit time reduction was considered as a winning tool. In this respect the author points that strategic decisions undertaken by

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[3] According to Gray and Menachof (1998) the expression international logistics is considered more appropriate and more realistic in the operation today. Contrary, global logistics is more theoretical and possibly a goal to achieve in the future. Much international trade continues to take place between independent corporations based in different countries maintaining regional / national autonomy. Terms of sales are different, thus by definition cannot work in an ideal integrated logistical system.

Liner operators becomes a dynamic artery to reinforce or reduce supply chain competitiveness. Towards this extent the author takes the view that no longer should be the time where Liner operators form strategies to their own merits being less in conformance with the overall supply chain competitiveness. The question to be raised in the following chapters is whether Liner operators have alternatives in order to offer less transit times and positively enhance the competitiveness of a value chain (cargoes originating from the Far East to the East-Med).

2.1 The Logistics Rationale

2.1.1 Logistics and Supply Chain Management

Companies invested over the years time and capital towards making products, and thought little of the means of making them available to customers, Waters (1999) p 3. Furthermore, in Waters (1999) p 3 the significance of transport is identified and physical distribution is described as 'the economy's dark continent', a term coined by Drucker (1962). This element of transport was neglected, whereas, it should be considered as the most promising area of the business. This was the start in acknowledging the concept of logistics, and it took several years to justify the concept's importance. In a 1996 survey by Deloitte and Touche in Canada, see Waters (1999) p 3, it was revealed that 98 percent of respondents stated that logistics and the supply chain are critical to any organization. This modern concept resonated worldwide as a business priority because of the competitive advantages it offers. According to the *Council of Logistics Management* (2003),

> "*Logistics is that part of the supply chain process that plans, implements and controls the efficient, effective flow and storage of goods, services and related*

information, from the point of origin to the point of consumption, in order to meet customer requirements".

Furthermore, the Institute of Logistics and Transport defines a supply chain as, (Waters (1999) p 5,

"*A sequence of events intended to satisfy a customer. It can include procurement, manufacture distribution and waste disposal, together with associated transport, storage and information technology*".

This definition includes all the parameters of logistics within an organization which no longer focuses on manufacturing products. Instead, it uses a supply chain process to satisfy customer demand.

Christopher (1998) points that while logistics is a planning orientation and framework that seeks to create a single plan for the flow of product and information through a business, supply chain management builds upon this framework. Thus supply chain management seeks to achieve linkage and coordination between processes of other entries in the pipeline, i.e. suppliers and customers, and the organization itself. For example, one objective of supply chain management can be to minimise inventory that exists between organizations in a supply chain through faster transit times and the exchange of information.

2.1.2 Importance of Logistics

The importance of logistics became evident and crucial to address for several reasons, Waters (1999) p 4:

- Inventory - moving and storing products carries an expensive burden;
- Customer satisfaction - the more efficient the logistics, the higher the satisfaction of the customer;

- Introduction of new techniques for operations, e.g. Just In Time (JIT) and Quality Management;
- The need to integrate operations amongst partners, collaborators, strategic allies;
- A global understanding that the supply chain is crucial and any related decision has a major impact on any organization;
- Creating a new perception towards transport. Over the years, rapid advances in the technology of transport, as well as, limitations, e.g. congestion of inland transportation routes, have taken a place;
- Improvement of communication processes through technology such as Electronic Data Interchange (EDI); and
- The enormous growth of international trade.

2.1.3 Logistics Functions

Points raised in 2.1.2 are important elements in today's customer service competitive environment. In the past, organizations attempted to segment the various functions and activity costs. For example, product locational facilities, inventory control, procurement, warehousing and transport, would each be considered as a separate functional activity. Today's approach is to consider them as a global function within a Total Logistics Supply Chain. The spectrum, according to Waters (1999) p 4, is broader and more detailed. The function of transport relates to physical distribution, then to logistics and ultimately to supply chain management. Throughout the many stages, it is apparent that all functions fall under the heading of the supply chain. Waters (1999) pp 5-6 points to several benefits accumulating from the logistics supply chain integration:

- A close link and a more authentic collaboration amongst all partners within a supply chain;
- Avoiding, to a great extent, repetition of tasks, data, information, planning;
- Avoiding or reducing, whenever possible, operational activities that do not add value to the product;
- Boosting effectiveness, efficiency, productivity, and simultaneously reducing costs;
- Minimizing inventory and accelerating response, by utilizing transport more effectively; and
- Establishing instant and reliable information transfer amongst parties.

In Ballou (1999) p 11 it is emphasized that the scope of logistics is to offer value towards customers and suppliers of the firm. The actual objective relates to product value and is expressed through 'time' and 'place', Christopher (1998) p 39. The field of logistics focuses on every activity within the supply chain as a means to offer more value towards the product. If insufficient value is being contributed, then a reassessment of the activity is needed.

2.1.4 The Value Chain

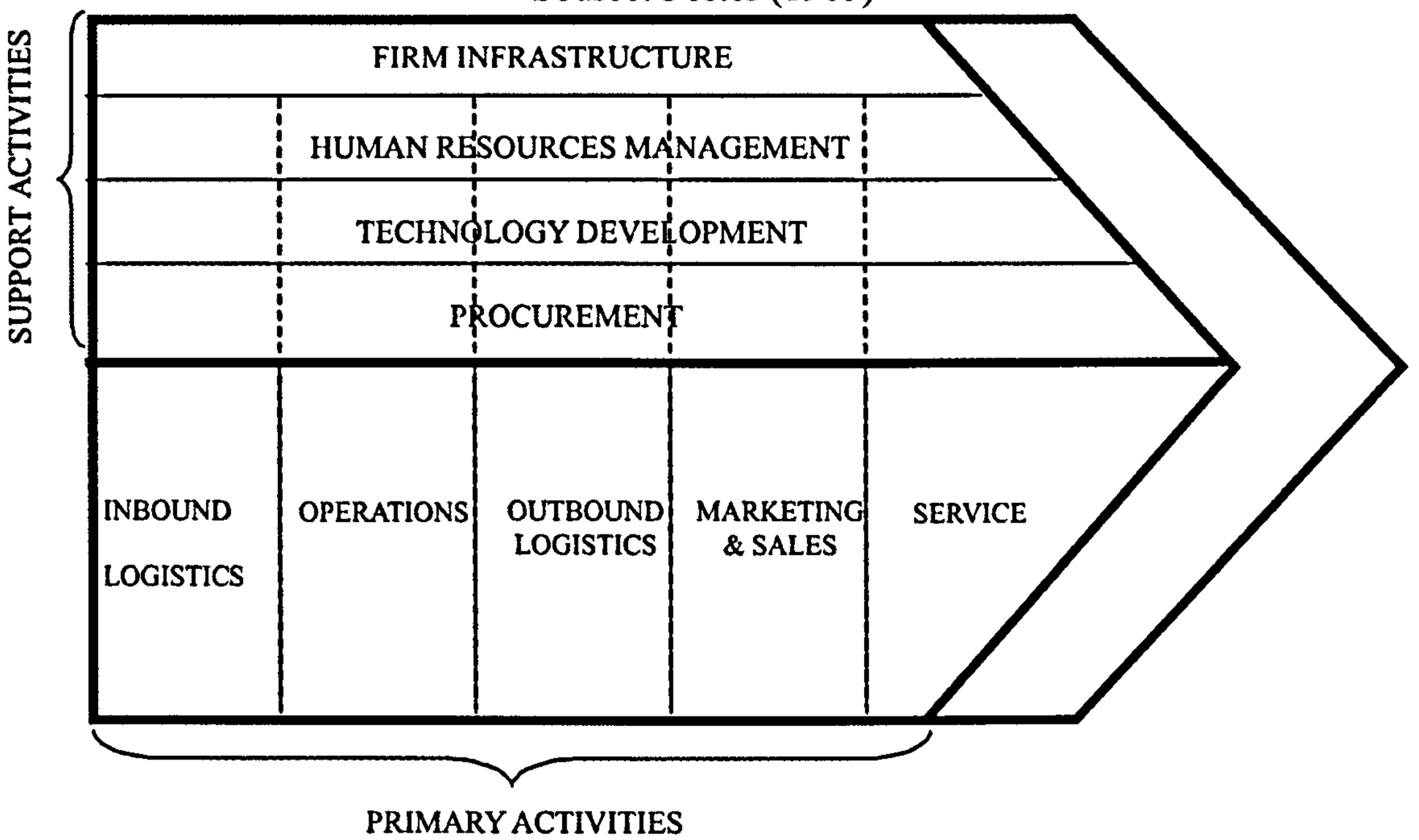
Firms today spend large sums of money and time in seeking techniques to differentiate their products from competitors. The concept of 'value chain', introduced by Porter (1985) pp 39, relates to acquiring a competitive advantage through the supply chain. Each of the category value activities, e.g. inbound logistics, outbound logistics, operations, marketing, sales, and service, contribute to an organization's competitiveness, and forms a module of differentiation. Furthermore, the latter author argues that product differentiation is a winning tool leading to competitive advantage.

According to Porter (1985) pp 39-40 emphasis should be given to the following primary activities: (See also Figure 2.1)

- Inbound logistics activities associated with receiving, material handling, inventory and warehousing.
- Operations activities that are associated with transforming inputs into the final product form.
- Outbound logistics activities, that relate to collection, storage, scheduling, warehousing and distribution of the product to the buyers.
- Marketing and sales activities which provide the means through which buyers can purchase the product and inducing them to become more eager through advertising, promotion, sales force and pricing.
- Service activities that are associated with offering such service in order to enhance or maintain the value of the product, e.g. repair, training and parts supply.

Porter (1985) p 40 concludes that all the categories of these primary activities will be present in all firms and correlate to competitive advantage. Thus, the more value is added to these activities the greater the competitive advantage.

Figure 2:1: Generic Supply Chain
Source: Porter (1985)



2.2 An Overview of Today's Supply Chain

Christopher (1998) p 5 argues that commercial success in all business derives either from a cost advantage or a value advantage or both. More precisely:

- Cost advantage originates from economies of scale that enable fixed costs to be spread over a greater volume. At the same time through increases in sales and market share relative costs decrease.
- The value advantage seeks areas for product differentiation by generating more benefits for the consumers. Such benefits may be intangible and relate not to the specific feature of the product itself, but instead towards making the product more valuable through service.

Christopher (1998) p 38 supports the view that more companies worldwide are becoming very service sensitive. Fundamentally, this originates from the contemporary perception that product brand loyalties no longer exist. Especially with the increasing convergence of automation technology among products, it is no longer advisable to compete on product difference alone.

Nowadays, both of these concepts are acknowledged worldwide. Thus, companies are seeking various sophisticated methods to add value to the supply chain.

A function that supports the Value Chain competitiveness is through time compression. Towill (1996) p 17 remarks that time compression is a powerful strategic tool within the supply chain, and suggests key drivers that add value to the chain and boost competitiveness:

- improved demand forecasting
- quicker to the market
- shifting decoupling point much nearer to the customer
- quicker defect detection

This is evident since consumer needs and demands have grown and companies continuously search for various methods to acquire a differential advantage, Stock & Lambert (1992) p 73. Today companies sell and market not only their products but the process of logistics itself. It has become evident that logistics can be used effectively as an offensive weapon to gain competitive advantage. Christopher (1998) p 16 emphasizes that, real competition today is not company against company but supply chain against supply chain.

The supply chain bolsters this strategy by coordinating the necessary activities and introducing the desired levels of quality service at the lowest possible cost. It provides the link to the operational activities within any business. Through the supply chain, companies have realized that service quality, cost reductions or margin improvement affect all the supply chain partners, i.e. the supplier's service and additional costs should matter to all parties concerned, either upstream or downstream, since, ultimately, total costs make their way to the final market place that reflects the action/reaction of consumers Christopher (1998) p 16. Furthermore, each segment in the product process optimizes according to their customers' needs. The real optimization, though, is the total outcome of the business such as, production, finished goods inventory, warehouse space, distribution, sales, working and capital.

Many complexities and parameters are evaluated whilst management is considering options on manufacturing, distribution, availability, sales and support. The term availability of the product within the supply chain pipeline is fundamentally important, especially in relation to transit time and stock holding.

In the mid 1980's, stock within the supply chain was regarded as a principle of "protection", i.e. securing against possible demand and supply fluctuations, upstream or downstream. In light of today's complexities, this perception changed radically since it diminishes flexibility and has a heavy impact on costs. The idea, as it is perceived by large companies, is to maintain minimal in order to allow faster distribution, thus making products readily available in the market. Time is of critical essence, and many companies today apply techniques, such as JIT (just in time), defined in page 44, and the implication being faster to the market, and aim for minimal stock, Christopher (1992) p 153. The father of JIT, Mr. Taiichi Ohno of Toyota, led the way and many others quickly followed.

In general the product of today should respond to the mechanisms of flexibility, availability and quick response towards demand. Interestingly, some organizations face a tradeoff consideration between of inventory costs and investing in time saving. Nine times out of ten, the time saving solution is chosen as a better alternative, Christopher (1992) p 128.

Nowadays for example, an information technology product can be obsolete within a few months, sometimes even before reaching the market. Consequently, most companies today have become extremely sensitive to their supply chain pipeline especially with respect to transit times and intermediate stock holdings. All parties within the pipeline seem to have realized the importance of this interlink.

Companies, such as, Rank Xerox, Benetton, and BMW, achieve their goals and recognition, despite the price element, through their supply chain service differentiation. The added value to their products originates from service excellence strategies focusing on commitment and quick delivery systems, Christopher (1998) p 24.

The shipping Liner operators are influenced to a great extent from this concept since their participation within the supply chain is crucial. Liner operators need to adjust their service to meet customer requirements within the supply chain just like all the other participants. An interesting point raised by Meyer (1996) p 5 is that a 20% longer transit time is regarded as a major disadvantage for any given Liner operator, consequently affecting negatively the supply chain. However, ultimately, the market dictates, companies follow, and Liner operators within the supply chain are expected to adapt accordingly.

2.3 The Lean-Agile supply chain and lead time importance

Lagoudis et al. (2001) p 353 by referring to Hayes & Wheelwright (1979), indicate that firms are forced to base their strategies on the nature of the products they produce and on the life cycle of such products.

Any form of strategy attempting to establish customer satisfaction and success in the market is based on a distinguishing attribute supply. More specifically, a summary list of distinguishing attributes per product category and the supply chain best suited.

The comparison refers either to lean supply chain or agile supply chain. Within the merits of demand patterns, products fall into two categories, either functional or innovative, see Table 2.1. A more recent third supply chain strategy is the combination of the two, named as leagile supply chain, introduced by Naylor et al. (1999).

2.3.1 The Lean Supply Chain

According to Naylor et al. (1999) p 352 lean supply chain means developing a value stream to eliminate all waste including the element of time and ensuring a level schedule. The lean enterprise, however, covers broader issues such as product design, product distribution, supplier sourcing and overall business strategy. All techniques apply to the entire supply chain, with the aim to eliminate waste, offer quality, and reach certain productivity levels (economies of scale).

Table 2.1: Distinguishing attributes
Source: Mason-Jones et al. (2000)

Distinguishing attributes	**Lean supply chain**	**Agile supply chain**
Market place demand	Predictability	Volatile
Product variety	Low	High
Product life cycle	Long	Short
Customer drivers	Cost	Availability
Profit margin	Low	High
Dominant costs	Physical costs	Marketability costs
Stock out penalties	Long term contractual	Immediate and volatile
Purchasing policy	Buy goods	Assign capacity
Information enrichment	Highly desirable	Obligatory
Forecasting mechanism	Algorithmic	Consultative

The origins of the lean approach date back in the U.K from 1915, see Aitken et al. (2002) p 60, and today numerous companies base their competitiveness on cost. For example, after the Second World War, Toyota developed extensively and very successfully a lean production tactic. The system was optimized by the reduction / elimination of any possible unwanted waste. In Evans & Powell (2000) p 30, five principles of lean thinking are set:

- *Value*: To specify what does and does not create value from the customers' point of view.
- *Value stream*: Verify all necessary steps to design order and produce the product or service towards the whole value supply chain and reduce to the maximum any non-value-adding waste.
- *Flow*: Work on those actions that generate value with least possible interruption, backflows, detours, delays or scrap.
- *Pull*: Only produce what is pulled / demanded by the customer.
- *Perfection*: Aim for perfection by constantly removing successive layers of waste as they are uncovered.

The author points out that for products supported by a lean supply chain, must critically consider the element of time compression. More specifically, the author argues that within a lean enterprise, ways must be found to eliminate costs relating to inventory, production, risks, capital exposure and overheads, that affect day-to-day business and are influenced by the lead time impact. Lead time needs to be minimized in lean manufacture, since, by definition, excess time is waste contrary to the principle of a lean supply chain Aitken et al. (2002) p 62. Wouters (1991) p 113, points out that lead time reduction in a lean enterprise may be very crucial for cost savings at several points on the production side. One such point is reduced labour overtime, provided time can be saved from other sources, like transport (by reducing the transit time). Furthermore, additional cost reductions can be achieved by reducing time, and thus the manufacturing cycle can be better aligned to demand, minimizing forecast errors.

However, lean supply chain is considered a less aggressive strategy than the agile supply chain.

2.3.2 The Agile Supply Chain

Agility emerged in the USA in 1990 with the purpose of making business more competitive, see Harrison et al. (1999) p 8. Volatile demand calls for quick response. Flexibility and ongoing rapid change characterizes the modern markets. The formation of an agile supply chain differs greatly from that of a lean supply chain, though based on similar tenets. Agility goes beyond the lean approach in that it focuses mainly on speed. The target of an agile organization is to offer greater flexibility. Harrison et al. (1999) p 8, remarked that within an agile enterprise the consumer is the very first priority. The agile business wins orders

focusing on flexibility, quick response and on the customer satisfaction. Customers, more or less, specify their market requirements and suppliers concentrate on the needs of the day. Agile enterprises cope easily in turbulent, unpredictable market conditions through flexibility, quick response, product variety and excellent current knowledge of the trading markets, Harrison et al. (1999) p 14-15. It is also pointed out that strategic agility is a continuous mastering of the forces of demand and constantly re-configure towards flexibility and responsiveness. Another major feature of an agile strategy is to seek opportunities for postponement within internal operations (Harrison et al. (1999) p 18-19. Postponement offers the possibility to delay the end product in the manufacturing process to the maximum. Such delay helps the suppliers to finish the end product at a later stage, thus increasing their flexibility and simultaneously eliminate their overall costs such as inventory, as well as avoiding risks, and minimizing obsolescence. Keeping a product at the "last common denominator" (final pre-assembly point) is part of the overall lead time advantage, in order to adjust and respond swiftly to market needs. The concept of postponement is also associated with the decoupling point[4].

2.3.3 The Leagile Supply Chains

According to Naylor et al. (1999) combining leanness and agility in one supply chain via the strategic use of decoupling point, suits best, the need for responding to volatile demand downstream, yet sustain, level schedule upstream from the decoupling point. Furthermore, Mason-Jones et al. (2000) remark that the decoupling point is also the point at which strategic

[4]According to Mason-Jones et al (2000) the decoupling point separates the part of the supply chain geared towards directly satisfying customer orders from the part of the supply chain based on planning.

stock is held as a buffer between fluctuating customer orders and/or product variety and smooth production output (see Figure 2.2).

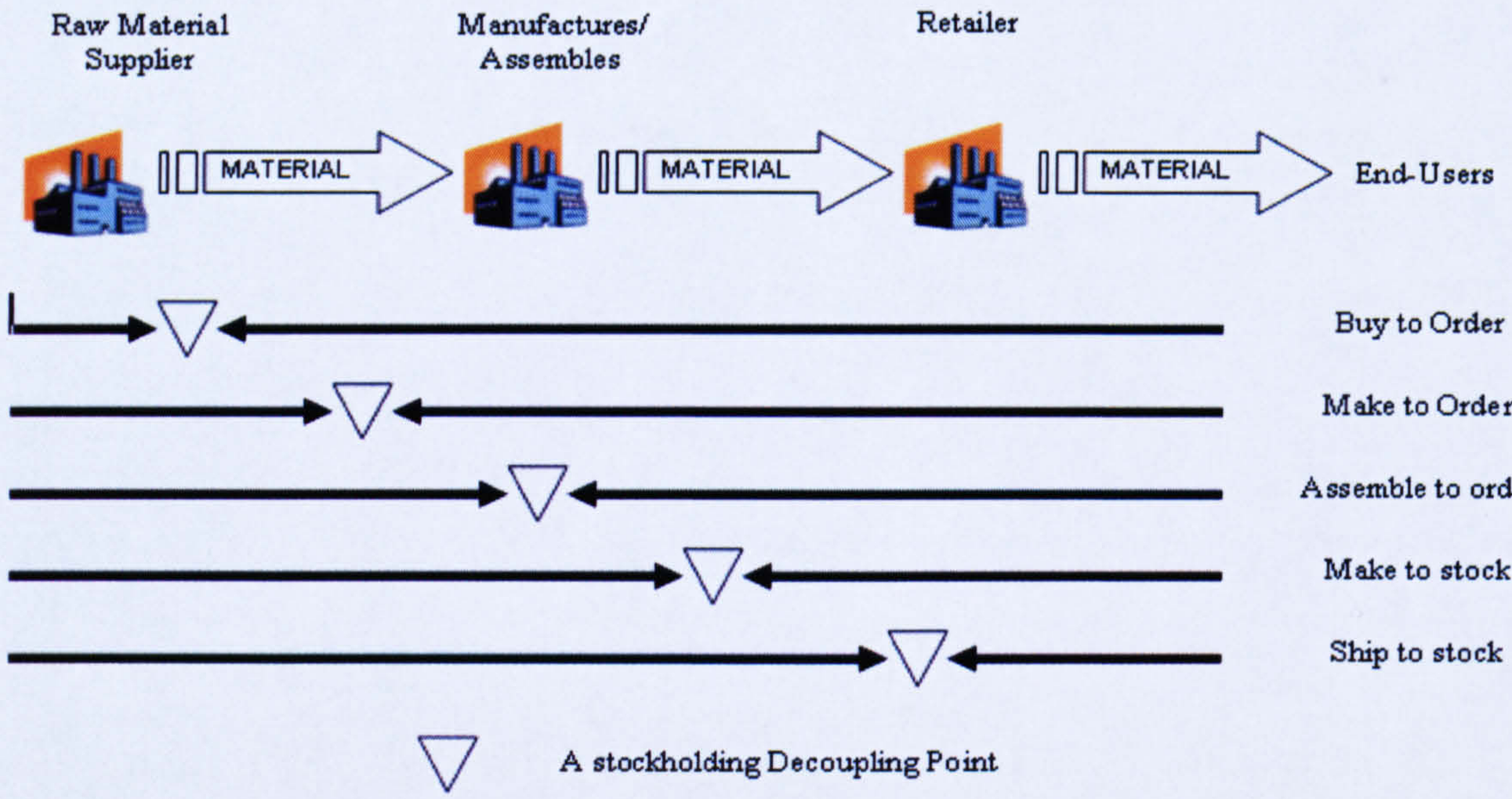
An example of a leagile supply chains strategy is given by Towill and Christopher (2002) referring to a case study of a national bicycle company. Specifically, two production seasons took place: lean in winter, agile in the summer. The bicycle company during the winter season worked on a lean supply chain (relatively stable demand, standard variety and focus on efficiency), while during the summer period the company introduced a mass customization scheme, where products were sold to the affluent market. Lead times in this agile mode were kept to absolute minimum and postponement was the answer to this success. In particular, frame welding, painting and assembly was postponed until individual orders were made, i.e. the decoupling point was located at the final assembler.

The combination of the above two lean-agile supply chains developed the, so called, leagile strategy, which according to Towill and Christopher (2002) both supply chains are not considered as mutually exclusive (the tendency has been for the benefits of the lean thinking to be restricted to the factory).

In such a case, the chain is lean upstream of the decoupling point (near the production process thus making it more efficient) and agile downstream (where it is closer to the customer) Mason-Jones et al. (2000).

Lean supply chain, agile supply chain and leagile supply chain require high levels of product quality and time compression. More specifically, Aitken et al. (2002) p 62, state that both lean supply chain and agile supply chain require minimum total lead time. In the thesis, the

Figure 2:2: Supply chain strategies based on the position of the decoupling point
Source: Naylor et al. (1999)



author focuses strictly on the transit time between the Far East and the East Mediterranean countries. Cargoes from the Far East vary though an indicative product ratio would be electronics (45%), toys (15%), clothing (20%), spare parts (10%), furniture (5%) and other (5%)[5]. Lagoudis et al. (2001) pp 352-354 point out that in adopting an agile supply chain the preference is to use fast ships and a frequent schedule, implying less transit time, thus resulting in overall reduction of lead time.

The author will investigate the possibility whether, for the traffic from the Far East towards the Eastern Mediterranean, transit time may be reduced thus promoting the aforementioned supply chains.

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[5] Personal consultation with G.A.P Vassilopoulos Ltd (2003)

2.4 Importance of Collaboration in Supply Chains

There was a time where many organizations concentrated all their efforts and attention towards, marketing, finance and production functions. While this is justified to a certain degree, such concentration is no longer sufficient for success. This is because other factors have entered the sphere of competition, such as activities that occur between places and times of production (supply) and places and times of purchase (demand), namely, the operations and logistics supply chain procedures, Waters (1999). These factors influence and affect the efficiency and effectiveness of both production and marketing. Furthermore the manufacturer policy is not any longer dictating supply chain and monitoring the path at which products are manufactured and distributed (push system). Nowadays instead, customers steer the wheel (pull system). All participants in the supply chain follow customer demand options towards style, features and fast deliveries. In other words emphasis is given to the "needs" of customers and not towards a product requirement. Towards this notion it becomes evident that successful market players will have to adjust their new roles accordingly Christopher (1998) p 15.

More frequently in the past relationships between parties involved upstream and downstream were poor and unjustifiably adversarial. Christopher (1998) p 33 points that each party considered their own objective as paramount, that is, the manufactures, shippers, transporters and consignees goals were relative only to their own operations. This is regarded as a short-sighted solution that possibly creates temporary winners.

Companies with this perception should acknowledge that, in reality, transferring any form of cost upstream or downstream does not make them more competitive. In fact, Christopher

(1998) p 16 emphasizes that ultimately, all costs will make their way to the marketplace with an escalating price to be paid by the consumer. Hence, the Darwinian rationale of "survival of the fittest" within a supply chain can be regarded as self defeating.

Menachof & Son (2003) names this relationship as transactional and remarks that price dominates; little information is shared, as well as minimal investment, minimal interaction amongst functional areas with small commitment and trust. The latter authors point out that further expansion of relationships requires resources, trust and commitment and establishment of common sharing long-term strategic goals. By definition supply chain management embraces significant difference from the traditional "transactional" or even adversarial relationship. According to Christopher (1998) p 18, the focus of supply chain management is towards the management of relationships with the purpose of having multiple profitable winners. Van Goor (2001) p 254 formed an embracing definition for demand / supply chain management:

> *"The management of a network that links customers and suppliers as one single entity with the objective to create value and reduce waste through voluntary integration and coordination of the objectives with all independent parties in the network".*

Menachof & Son (2003) point out that since supply chain management priority has changed from mass production quality, to delivering customer satisfaction, a need for stronger collaboration exist. Menachof & Son (2003) remarks that there is no single definition of supply chain collaboration. However this may embrace a multi-dimensional approach named "the supply chain collaboration cube". Either forming a Type 1, applying logistics and virtual network or a more extended definition of supply chain management; (beyond logistics) Type 2, the key issue is that collaboration becomes a dynamic artery for success. It takes money, time, and effort, and may be regarded as an investment. Liner operators will have to work

with their partners to decide the level of collaboration with any part of the system within a greater supply chain network, i.e. another operator, terminal, shipper, transporter. Evidently, through time the Liner industry experience lower freight rates while costs continue to increase. Menachof & Son (2003) point out that effective collaboration forms an important vehicle to better cope with this trend. Towards this notion, the Liner port industry being enormously capital intensive, aggravated by intense competition, acts on similar tenets. More specifically Song (2003) supports the view of collaboration even where competition may exist through co-opetition (co-operation and competition) (see Section 3.2.3).

Effective logistics collaboration pertains also the flow of information. The internet provides a significant tool that integrates all trading partners across the supply chain. End-to-end supply chain visibility improves the cash-to-cash cycle for all trading partners, i.e. Liner operators may offer added value benefits through e-procurement systems that promote real time supply chain visibility to all collaborators (see section 2.8 below). It becomes clear that as competition focuses on mass customization, virtual supply chains[6] and short product life cycles, the value chain needs to seek improvements with their collaborators based on trust, compatibility of aims, objectives, values, inter-dependency and more integration, (Anastasiades & Skarpetis 2001).

Although the form of collaboration[2] is a key issue, according to Van Goor (2001) p 250 the success of supply chain management will depend also upon the choice of the specific partners in the supply chain. Svensson (2002) p 15, remarks that supply chain between companies

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[6] Christopher (1998) p. 226 indicates that a virtual supply chain is a series of relationships between partners that is based upon the exchange of information, creation of partnerships, synergies for the purpose of more value creation and value delivery systems.

sometimes causes vulnerability because of dependencies. Such vulnerability is of critical importance, since most of today's logistics flows are considered to be heading towards both lean and agile. Vulnerability can be conveyed to a company as a result of negative consequence transferred from another company, e.g. a partner in the supply chain, such as, Liner operators. Furthermore, vulnerability is also evident when segments of the supply chain are dictated by other partners without the suppliers' participation and involvement. The latter comments that vulnerability leads to the necessity of closer collaboration in order to achieve common goals. Quinn et al. (1990) p 65 point out the management of successful firms frequently put forward questions such as: Are we really competitive with the world's best here? To what extent does this apply and what kind of improvements need to be made in terms of intelligent outsourcing, coalitions and collaborations. Is the emphasis targeted on potential providers choosing the "best in their activity?"

Large organizations today use the phrase "the best with the best" to convey their wish to cooperate with successful partner supply chain, thus ensuring their competitiveness e.g. Procter and Gamble and Nestle. Within a supply chain a shipper, amongst other, would request the best transit time commitments from a Liner operator contributing to the 'products' competitiveness. With the introduction of door to door service in the sector of Liner shipping, the focus was to minimize lead times in the supply chain. In order for full benefits to be gained, investments were made in fast ships, seaports and terminals based on rationalization and economies of scale, Lagoudis et al. (2001). The overall potential was to match transport dynamics to present day customer needs. Companies need to acknowledge and link their organization with outsider participants of the chain, hence creating a global joint team. Quinn et al. (1990) p 65 remarks that there is a strong correlation amongst companies' supply chain

partners and product success. Collaboration and service driven logistics play a role in meeting the precise needs of customers in less time than ever before.

2.5 Supply Chains Focus on Less Inventory

2.5.1 Inventory Importance

Inventories constitute any form of raw materials, components, finished goods and work in process that appears within the supply chain. These are found for example in warehouses, during transportation in yards, and on shelves'. Christopher (1998) p 113 refers to idle stock as vertical time, incurring only costs. Ballou (1999) p 308 remarks that inventory in hand may cost between 20% and 40% of products value per annum. Inventory means locked up capital, interest payments or lost revenue interest, warehouses, warehousing running expenses, increases in damages, expiry date losses, actual physical losses, increase of insurance premium costs, and administrative expenses. Evidently, all these in the end increase the cost of products with the unavoidable threat that the supply chain becomes less competitive in the market.

According to Cooper et al. (1994) p 57, in the U.K. alone, inventory locked up forms a capital of approximately 80 billion UK pounds, which represents approximately 20% of the actual value being manufactured. Furthermore, the latter author argues that international competitiveness amongst countries is also affected by this issue. Japan, for instance has an inventory burden of 10.5% of its manufacturing output, that is, approximately half the burden of the U.K.

2.5.2 Lead time Affects Inventory

The author at this point raises the issue of time as a means to optimise the total outcome of the business. For example, production, inventory, working capital, sales, and warehouse space, i.e., processes within the company's downstream activities towards the customer (distribution) and upstream activities including procurement and relationships with suppliers. Time is of critical essence since it connects all parameters and contributes towards success. The introduction of JIT[7] (just-in-time) is a strategic decision based on the merits of time. It is a concept that fosters quick response to the market with minimal stock. Many companies have followed this recipe successfully, e.g. Rank Xerox and Bostrom, see Cooper et al. (1994) pp 60-61, and it is likely that this notion amongst companies will continue to grow. The notion of time reflects a pull technique. Ideally, suppliers / buyers of products would prefer everything to be demand driven. This could entail less risk since nothing is ordered, manufactured or transported unless there is a demand. This rather complex issue pertains to logistics management, i.e. seeking ways to minimize time, hence excess inventory cost, without affecting the supply chain. Many companies are moving in this direction, focussing on time reduction and thus affecting many parameters, including forecast accuracy, Christopher (1998). According to Thacker (2001) the possibility to reduce supply chain lead time automatically reduces the risk of possible forecasting error. Since demand forecasting is becoming very difficult, minimizing lead times is the only effective recipe.

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[7] (In the broad sense) An approach to achieving excellence in a manufacturing company based on the continuing elimination of waste (waste being considered as those things which do not add value to the product).

(In the narrow sense) Just-In-Time refers to the movement of material at the necessary place at the necessary time. The implication is that each operation is closely synchronized with the subsequent ones to make that possible. European Logistics Association (1994)

According to Towill (1996) p 17, as a rule of thumb reducing the lead time by 50%, can reduce forecasting error by 50%. Such a prospect can enormously affect capital gain, not only by reducing inventory but also by bringing orders more accurately in line with demand. Fischer (1997) p 113 says that the cost of maintaining the inventory of a given product for a period of one year equals 25% of what was paid for the product. Therefore he concludes that a two week inventory reduction equals a cost saving of approximately 1% of sales.

Morash & Clinton (1997) p 6, point out the importance of moving the pipeline inventory in faster transit times. Their survey of literature claims a 20:1 ratio 'in terms of dwell[8] time' ratios. Thus, for every day that inventory is in the transport pipeline, it is expected that it remains idle for 20 days within the overall pipeline.

Christopher (1998) pp 168 points out that accuracy of demand data is a partial solution. In a sense, it is regarded as a mere forecast and as such never accurate. Furthermore, he states that whereas in the past logistics systems focussed on forecast techniques, with many complexities involved, today's focal point relates to lead time reduction. In addition, Christopher (1998) pp 172-173 refers to the demand penetration point where the logistics chain meets actual demand. This procedure allows the upstream to experience an immediate response stemming directly from the market place.

Procter & Gamble, use such techniques, collecting latest data from the marketplace in order to respond quickly to future demand, Christopher (1998) p 193. Apart from quick response, their objective is to save time and avoid excess inventory, something that would inevitably cause an escalating cost burden. Either upstream or downstream, inventory for Procter &

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[8] Dwell ratios are the average number of days inventory is moving compared to the average number of days it remains idle in the pipeline

Gamble is one and the same since the end product will carry the burden to the marketplace. It is generally accepted though, that market volatility ensures that forecasts, will be inaccurate irrespective of innovative sophistication of the techniques employed. The root cause of these problems is that forecast error becomes proportionally larger as lead time increases (Christopher (1992) p 129. Furthermore, Christopher (1998) p 153 elaborates that demand volatility tends to increase due to many variables such as market forces, prices, and competition. Even short term changes are enough to create obstacles in forecasting. All parameters are important features towards competitiveness, though the element of time, referred to as lead time[9], is the factor of optimisation.

The element of time becomes crucial, reflecting the quantities to be ordered, especially the safety stock. Furthermore, as lead time decreases, it enhances quick response. Another parameter is that many companies face considerable problems in identifying their weaknesses within the supply chain. A major reason lies in the easy option, taken by companies, to maintain excess safety inventory. Excess inventory hides the problems within the organisation and works negatively within all departments of the organisation, as such abnormal inefficiencies and inconsistencies of people are less visible. It can become extremely difficult to identify loopholes within the chain, since the problem is not visible. In fact the problem maybe actually absorbed by the excess inventory, which creates direct knock on effects, escalating product costs, Christopher (1998). Stalk (1988) p 46 points out that in case of longer lead times, a domino effect occurs since forecasts become less accurate regarding planning and thus inventories balloon at all levels. This is called the planning loop where solving the problem must eliminate any time wastage throughout the system.

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[9] According to Christopher (1998) p 31, lead time is defined as the time it takes from the procurement of raw materials and subassemblies, through the delivery of the end product to the consumer.

2.5.3 Areas of Improvement

Ballou (1999) p 318 identifies five areas of inventory costs that supply chain logistics seek to improve, all relating to time:

Carrying costs: Carrying costs relate to inventory expenses from holding goods for a period of time plus storages. These in turn are subdivided to four types:

Capital costs: This is an intangible hidden cost and refers to locked capital. Ballou (1999) p 318 claims that this inventory item contributes up to 80% of inventory total cost. It correlates with time and forms a cost towards capital (interest rates) as well as to the opportunity cost of capital, typically rated at 25%. Thus, assuming fewer inventory, then less capital would be required and a company could plan alternative investments. This way, enhancing growth opportunities and/or creating more value to the product.

Space costs: A major cost burden relates to the storage building and storage rates, if rented. There is a correlation of costs in relation to inventory volume; the more stock, the greater the costs. Large volumes usually imply an investment to acquire a building. Hence, costs accrue to build or buy and then to operate a fixed asset. Running costs range from small items such as light and climate control to expenses for heavy machinery, personnel, and technological equipment.

Inventory service costs: Insurance and taxes are within the sphere of inventory carrying costs. Thus, insurance coverage works out to be about 1% premium costs for protection against theft, fire and losses. Taxes are regarded a minor portion of total carrying costs.

Inventory risk costs: This relates to the costs affecting goods in terms of deterioration, damages, shrinkage, theft and obsolescence (expiry dates). The larger the stock, inevitably a certain quantum of products will suffer losses through damage, contamination, expiry, and

deterioration. Ballou (1999) p 318 argues that such inventory, regarded as a direct loss of the product value, can range from 2% upwards in terms of carrying cost.

A lost sales cost: This non-tangible cost is considered to have a major multidimensional knock on effect. Cases do arise where customers are not satisfied due to out of stock situations. The cost burden is double. Firstly, it involves the profit for the lost potential sale. Secondly it involves the negative knock-on effect of the customer seeking alternatives, with the possibility of losing the client. The author raises two further points, again involving the time factor. The first relates to quick response in cases of out-of-stock situations, and the second values the importance of time regarding the introduction of new products into the market. In today's competitive era, introducing and making a new product available in the market before the competition is a crucial and winning criterion.

2.6 Customer Service

Christopher (1998) p 24 defines customer service as "the consistent provision of time and place utility". Hence, products do not carry any value until they are safely in the possession of the customer at the place and time needed. Christopher (1998) concludes that customer service is the interaction of various factors that influence and affect the process of delivering products and services available to the customer. Furthermore, Christopher (1998) p 62 defines the following most important elements of customer service:

- Order cycle time
- Consistency and reliability of delivery
- Inventory availability

- Order size constraints
- Ordering convenience
- Invoicing procedures and accuracy
- Claims procedure
- Technical Support
- Documentation Quality
- Frequency of delivery
- Delivery reliability
- Order status information

The above elements do not necessarily carry equal weight and Christopher (1986) p 68 points out that each market serviced by a supplier may attach different weights. However, Christopher (1986) p 69 remarks that a supplier will have to establish those components of the overall customer service mix that create the biggest positive impact on the buyer's perceptions. Christopher (1986) describes this as a customer service package embracing many components. Thus, for example, where market segments involve great volatility of product demand and cargoes originate from great distances, lead time improvements should carry more weight.

In Ballou (1999) p 84, it is shown that, amongst all elements of customer service, the most important were logistical in nature. It is not a coincidence that successful companies like BMW, Xerox, Benetton, and Dell Computers, consider logistics service a high priority. These organizations gained a high level of recognition for service excellence, by offering a differential advantage over competition (Christopher (1998)).

The Malcolm Baldridge National Quality Award[10], see Stock & Lambert (1992) p 73 includes winners such as the world leaders Federal Express, IBM, Motorola and Xerox. Thirty per cent of the 1000 points considered in the evaluation of firms for this Award are based on customer focus and satisfaction derived from a logistics advantage. In another research study for auto class, Ballou (1999) p 84, it is pointed out that 6 out of the 10 most important attributes relating to customer service were logistics oriented. Similar results are revealed in the industry office systems and furniture sectors. More specifically, reference was given to the frequency of delivery, stock availability and transport particulars. In two surveys mentioned in Ballou (1999) p 84 the results are interesting. In the first case product availability, order transit time, time for assembly and shipping were the most important criteria for 63% of respondents. In the second case, cost of service was remarked by only one respondent and speed of delivery was rated as first. Through an in depth analysis, see Ballou (1999) p 90, it has been showed that there is a high correlation between product distribution and sales increase. Thus, providing an upgraded service standard, through distribution can lead directly to more sales. Buyers are sensitive to the service level provided by suppliers. Thus, any improvement towards better service is a driving motive for shippers to shift their business. In Ballou (1999) p 91, it is stated that logistics oriented customer service is extremely crucial for the existing clientele to remain loyal to the organization. More than 65% of a firm's business originates from its current customers. It is also noted that it is nearly six times more expensive to acquire a new account customer than to maintain an existing one. In today's competitive era customers perceive minimal technical difference amongst products. The differential advantage will originate from added value through customer

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[10]Malcolm Baldridge National Quality Award established in 1987 USA by public law to boost and develop quality awareness. (USA)

service. A product's added value will include any minor or major feature designed to make it sell better. In cases where added value provides a differential advantage such as speed, this may have a direct impact on sales increases.

Sifniotis (1997) p 80, points out that companies today consider that logistics oriented customer service value may be more important than the characteristics of the product itself. Ultimately, customer satisfaction derives from the quality of the product and the high level of service. According to Dean Cassell, see Blackburn (1990) p 396, vice president for product integrity at Cruman Corporation, speed and quality go in tandem. Thus, speed complements and is a component of quality. Inevitably, the prosperity of any company accrues from customer satisfaction; otherwise the whole venture will cease to be viable. Every organization, needs customers, and most importantly, satisfied customers with the ultimate objective to increase profits. The top hierarchy of any organization understands that a strategic plan is needed in order to focus on customer service standards. Such procedures will have direct positive repercussions on sales, costs and profits.

From the above discussion it is clear that companies can gain a competitive edge through efficient logistics and supply chain operations, that impact directly on customer service and satisfaction. This underpins the importance of adopting a supply chain approach to examine the concept of transit time.

2.7 Time-based Logistics A Source of Competitiveness

In Beesly (1999) p 180, it stated that time is the last exploitable resource, recollecting the notion that 'time is money'. Time represents a fundamental factor in satisfying customers and

differentiating from the competition. Both elements affect the way that organisations define their core competence. Competitive forces throughout the world give impetus to enormous pressures on markets and their supply chains, Beesly (1999) p 180. High-cost producers cannot claim any longer product quality at the expense of low-cost producers. Thus, the longer established supply chains that depend on high cost labour continuously seek new ways to compete. The element of time represents an important tool to optimise cost and service by focussing on customer needs. Blackburn (1990) p 398 emphasises that, in order to create market advantage, companies must be time focused and aim towards reducing time from all operations instead of solely reducing cost. Time reduction may leverage the extra tools necessary for profitability whereas cost reduction may not. This line of thought boosts customer satisfaction, which in turn increases sales. Hence, time is converted to money (Blackburn (1990)). To advance this notion, crucial changes need to be made in all functions that correspond to product delivery or customer service, e.g. transit time.

A European survey of industrialists (Beesly (1999)p 180) revealed their focus on time as a future source of competitiveness. Hence, the current approach focuses on how organisations utilize time to perform and deliver a sustainable rapid response to customer needs through a well-structured strategic objective. Millson et al. (1992) p 53, point out that product life cycles are becoming shorter, forcing firms to minimise the time required to bring new products to the market.

In Beesly (1999) p 180, it is commented that product variety will continue to expand, with high standard of service and faster levels of innovation. Their study focussed on the value adding elements of the supply chain processes and specifically on time-based competition. Time-based competition was introduced by Stalk and his colleagues at Boston, see

(Blackburn (1990) pp 406-407), and is considered to be an extension of JIT. They deduced that a firm achieving an important time advantage in product delivery, changes the nature of competition in the entire industry. In fact, cost may be regarded as secondary to response time. Both JIT and quick response have common objectives, and the goal is to minimise all time wastage either in the production or the delivery of a product. However, time-based competition is a step ahead of JIT, embracing the complete value-delivery chain of the product. All peripheral activities within the supply chain lead time must add value. People must work faster and so must the resources and services along the chain. The objective would be to establish a "time compression", (see Beesly (1999) p 181), where time spent by business processes eliminates non-value adding time.

According to Morash & Clinton (1997) p 13, Japanese industries, in particular, consider time compression as the most important supply chain organizational factor together with JIT delivery, information support, low logistics cost and standardisation of process.

Amongst the various processes within the logistics chain, transport transit time forms an important parameter of time compression. By compressing transit time, and thus minimizing lead time, the inbound supply chain is compressed. Morash & Clinton (1997) p 5, confirm that time compression in the supply chain can be achieved in various ways, one of which is also through faster transit time. Hence faster transit time may free up time amongst other functions of the supply chain, which further reduces total costs.

In addition, time has an impact upon commercial competitiveness. This is an external time within the supply chain that conveys direct value to the customer, (see Beesly (1999) p 182).

It is also argued that competitiveness in the market originates from three basic elements namely, the customer, the competition and the company. There should be a differentiation of value and cost, if competitiveness is to be acquired. Through time compression, the differentiation objective is accomplished by minimizing time, thus maximizing the value gained in the value supply chain. Simultaneously, the elimination of non-value time activity provides a cost advantage, thus acquiring the differentiation of cost.

Mendez & Pearson (1994) p 8 provide three dimensions for products to keep up with the market, namely quality, cost and time. Stock & Lambert (1992) p 76, state that the element of quick response is rated very high in every industry. Thus, the ability to expedite emergency orders and distribute products fast in a responsive manner is highly rewarding in the market.

Stalk (1988) p 45 points out that becoming powerful in the market requires customer satisfaction through rapid response, which is a far better tool than traditional strategies based on for example low wage scales. Furthermore, Stalk (1988) p 45 comments that companies such as Sony, Matsushita, Sharp, Toyota and Hitachi, regard time compression as being their most important competitive weapon. Their effort to reduce time consumption in every aspect of their business has succeeded not only in generating more revenues and being close to the customer, but also in reducing costs and upgrading the quality of their products.

Interestingly, Beesly (1999) p 187, it is concluded that customers, in general, appreciate the element of time obtained from suppliers, and are keen to pay more for their products based on subjective and economic reasons. Some of the justifications are targeted on the following:

- The customer prefers less stock in hand

- The customer can delay making a decision and can decide nearer the time needed, thus minimizing risks
- The cash flow velocity is increased
- Orders can be cancelled/changed less frequently, due to short time
- Faster response to the market demand.
- Better chance to increase market share by being faster, thus more flexible

Furthermore, it is stated that time-based suppliers will grow at three to four times the rate of their competitors, three times faster than overall demand, and with two times the profitability level, see Beesly (1999) p 188. On the contrary, the slower competitors, before deciding to form a time-based strategy, will incur the costs of regaining market share, which is very costly.

Modern organisations seek to reduce the consumption of time throughout the system, both internally and externally. Surprisingly, some firms found that only 10 percent of the total time spent was an added value, 90 percent represented added cost, Christopher (1998) p 113.

According to Blackburn (1990) p 395, the Japanese firms are vulnerable to U.S. products even though they have formed time-based strategies. He concludes that their vulnerability stems not from product differentiation but from the lead transit time required to transport the products across the Pacific. Reinforcing the above point, namely the fact that the time compression is also related to transit time, the following example is considered: Procter and Gamble, a world leader of consumer products, restructured its production and distribution functions in order to regain market share lost during the 1980s. Consumers at that time perceived Procter and Gamble as being slow in responding to the customer. One of the key

areas 'John Smale the CEO of Procter & Gamble in 1987, see Blackburn (1990) p 405, successfully established was a time-based strategy that minimized production time and developed time compression amongst various activities. In 1985, Procter & Gamble claimed seventeen of its products as being market leaders, while in 1989 there were twenty two at that level.

According to Blackburn (1990) p 398, a time based strategy attempts to transform the whole company towards focussing on the total time it takes to deliver a product to an end customer. The actual goal is not how to seek solutions in terms of the best way to perform the task but to perform in a time compressed manner so that response time is reduced.

The author notes the issue of transit time affecting the overall lead time. Consequently the transit time should be as short as possible, without sacrificing the reliability and quality of service.

2.8 The integration of Transport within the Supply Chain

2.8.1 The rationale

Through the last years the Transport rationale has changed: Historically a Liner operators' consideration regarding service was based on the transportation perspective and to a lesser extent on the Shipper's marketing effort. Today carrier's roles and responsibilities are undergoing an overall reassessment.

According to Morash & Clinton (1997) p 5, transportation integration is vital within the supply chain since it can maximise customer value and reduce total costs. Integrative transportation forms the path where products must be delivered at the right place, in perfect condition, at the right time within the entire process of the whole supply chain. Towards this notion Wagner & Frankel (2000) p 246 argue that carriers form a critical element in the supply chain more as integrators in the whole pipeline, as information disseminators, transportation service advisers, and less as freight transporters.

Morash & Clinton (1997) state that the supply chain structure[11] aims to coordinate business processes within and across firms in the supply chain. More specifically, it drives the transportation capabilities relating to reliability, time compression, JIT delivery information systems support, standardization, flexibility and customisation.

Reliability: Information sharing is regarded as instrumental and fosters transportation reliability. In order to achieve integration, supply members depend on reliable deliveries towards both production and sales. When shippers have constant and accurate information from the transportation this positively erodes their boundaries within internal and external customers.

Time compression: Transit time originating from fast transportation minimizes pipeline inventories. In addition time saved in early arrivals frees up time in other segments of the supply chain and may trigger transportation to speed up its performance thus no adjustments will be required in the cycle time.

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[11]Supply chain structure: According to Morash and Clinton (1997) supply chain structure is considered to represent the organizational efforts by three or more firms to manage and integrate material and related information flows in order to get closer to customers. Supply chain structure involves both internal and external process integration. Internal integration involves the internal customers of the firm. It requires that transportation, procurement, manufacturing, and sales are coordinated and integrated to achieve customer value and satisfaction. Major external structural aspects include operational planning for JIT, transportation information sharing, and information technology links among supply chain members.

JIT-in-time delivery and information systems support: Unsynchronized transportation may create congestion, poor production, with negative financial repercussions. Coordination and information sharing at all times is critical, especially in today's volatile markets and virtual enterprises.

Standardization: The various processes in the transportation logistics chain are standardized so as to facilitate and provide better efficiency, e.g. pallet and container equipment, dangerous or hazardous cargoes physical standardization.

Flexibility: regular meetings and constructive dialogue amongst the participants of the chain enhance transportation flexibility. To this extent abnormal nonrecurring emergency situations is altered instantly when necessary without negative repercussions to the production and sales.

Customisation: Transport customisation involves markets or different supply chain members who demand specific tailor made additional services from transportation.

All the above elements form the very basis of competitiveness within the firm. Furthermore, Morash & Clinton (1997) p 5 point that transportation is fully coordinated to the specifications and timing of manufacturing as well as procurement and sales, so as to add maximum value. Likewise, transportation is influenced by and has an impact on external supply chain integration that joins customers, carriers and suppliers. Furthermore the shippers' choice of carrier is based on supply chain partnership, acquiring their assistance to increase market share as well as offering more value satisfaction to customers. The value element started to grow with the introduction of door-to-door customer service in the 1960s. Today, the shipping revolution takes the form of modern fast ships, whose actual aim is the minimization of lead times in the supply chain. However fast ships as a stand alone element is not enough. An extremely valuable tool for boosting the viability of this venture is the

choice of a seaport hub both from a geographical and an operational aspect (see Lagoudis et al. (2001) p 354). The choice of a hub is crucial and carriers today occasionally invest from their own resources to build hubs that are almost tailor made to their service needs, as well as the overall supply chain. However, the author takes the view that this strategy (vertical integration) sometimes stems primarily from market weakness when it fails to satisfy the precise needs of the Liner operators, see section 2.8.2 Transaction Cost Economics. Such examples are the Maersk Sealand investment hub in Algeciras, Contship hub in Gioia Tauro and Evergreen hub in Taranto. Carriers choose hubs, shippers choose carriers and customers choose supply products. All along the supply chain, all parties concerned rely on requests initially addressed from customers and, ultimately, the market place. According to Wagner & Frankel (2000), the supply chain reflects long term competitive advantages instead of utilizing a carrier for just cost freight reduction. Thus, the service provided by carriers is regarded as instrumental in acquiring and developing new clientele, as well as, in securing the existing ones. This service request originates from shippers who demand assistance from their carriers in increasing their market share. Carriers, on the other hand, must work jointly with shippers in providing value-added service to their customers in terms of personal attention, positive feedback response, and caring/courteous service. Furthermore, carriers today analyse customer service needs and requirements through scientific and technological means. In addition, latest commitments from carriers include satellite communication systems to customer in order to ensure availability of real time information and logistics consulting, as well as, special handling and monitoring of tailor-made enquiries from customers[12]. According to Charlesworth (2003) carriers held key elements of supply chain data and information in their system, which nowadays is used to improve supply chain visibility for

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[12] Personal Consultation with Hapag-Lloyd Container Linie GmbH

customers. From 1990 on, Liner operators have concentrated on developing global networks and building supply chain management systems in order to provide more added value operations and commercial help to their customers. Towards this notion major Liner operators offer affiliated logistics services, see Table 2.2, e.g. P&O Nedlloyd Logistics, containers status tracking and report system (stars) (developed to manage the inbound supply chain of Woolworth). Charlesworth (2003) further points out that Liner operators today look at the whole supply chain from the 'customer's point of view not only by providing a mix of services but to integrate end-to-end logistics solutions. For this to happen, carriers seek value added links in the supply chain to offer the ideal and most unique tailor service to meet customer needs. According to Wagner & Frankel (2000) the internet is used extensively to help suppliers especially as companies become linked in to "virtual corporation", i.e. in creating better internal and external communications, enabling more and accurate real time information to be obtained from different business partners over wider geographic areas, ensuring tighter inventory control, etc. According to Wagner & Frankel (2000) p 254, top rated carriers are changing their strategy from being traffic driven to customer driven entities. Carrier adjustments and conformance to customer demand are no longer optional. On the contrary, the carrier's role in the value chain today is far more competitive and demanding. Carriers need to acknowledge and accept the new role as a key sales tool conveyed to the shipper helping them to succeed in the market (Cooke (1996) p 31). Shippers' competitive weapon, namely the carrier, should be geared towards customer satisfaction. A crucial point raised by Wagner & Frankel (2000) is that time sensitive carriers are winning the battle in the marketplace. Furthermore, they point out in p 253 that survivor carriers will be those that entirely integrate services between shippers and customers. Thus, for the purpose of satisfying the shipper, customer and, finally, the consumer, carriers need to uniquely tailor their services accordingly.

Table 2.2: Liner operators offer affiliated logistics services.
Source: Charlesworth (2003)

Line	Affiliated logistics provider(s)	Services
APL	APL Logistics	Supply chain management Consolidation and vendor services Warehousing and distribution Global freight management Asset management IT solutions
Maersk Sealand	Maersk Logistics	Supply chain management Consolidation Forwarding Air freight Warehousing & Distribution
P&O Nedlloyd	P&O Nedlloyd Logistics	Forwarding Consolidation Freight management Warehousing & Distribution Project management
NYK Line	NYK Logistics New Wave Logistics	Forwarding Consolidation Warehousing & Distribution
K Line	K Line Total Logistics	Forwarding Consolidation Airfreight Distribution Trucking
OCL	OOCL Logistics	Supply chain management Vendor management Consolidation Bar-coding Hanging garments Information solutions

Since carriers, ultimately, should be an extension of shippers, it becomes imperative that carriers should seek amongst other, the least possible transit times.

2.8.2 Transaction Cost Economics (Liner operators' choice towards Vertical Integration)

Integration of sea and inland transport was initiated by the structured interdependence amongst the two transportation activities. Archambault (1989) points out that synchronization

of mainline containerships and inland transport unit train schedules create further economies of scale. These economic benefits are evident the greater the operational integration is developed. A governance structure is one of the questions set by Demsetz (1972); why is it that the gains from specialization of activity may be better attained within a firm rather than the market? For example, the market is one form of governance structure, from which source a firm may acquire input for its operations. On the other hand internal organization by adopting vertical integration creates another form of governance in which case enables the firms to operationally produce instead than purchase the inputs they require (see Williamson (1979)).

The Liner Industry bears witness to numerous investments being undertaken on behalf of Liner operators towards Inland transportation and related activities e.g. hub terminals offering a complete package of door-to-door logistics. According to Archambault (1989) the potential benefits to Liner operators include economies of scale and scope, facilitation of management and co-ordination (Hayuth (1987)) and greater routing flexibility (Mahoney (1985)). Furthermore some shippers identified further benefits such as service quality improvements, ease of transacting the business dealings, tracing of shipment and control over their shipments.

An interesting example of vertical integration is Sealand being acquired by CSX, a group that specializes in road and rail transport. The Liner operator can choose market contracts with inland logistics operators or they can vertically integrate through joint venture or acquisition, or by forming their own inland transport company. Williamson (1979) remarks that the most efficient system for organizing integration is through the application of transaction - cost economics. Transaction cost is classified into information costs, negotiation costs and

monitoring. Furthermore the transaction-cost approach concentrates on specific variables considered to be vital in the selection of the most efficient governance structure. That is the degree of asset specificity, uncertainty, complexity and frequency of transaction occurrence.

Williamson (1979) remarks that vertical integration becomes the most efficient option the more the above-mentioned dimensions increase. Thus if asset specificity is low then market organization is a better option whereas high asset specificity favours hierarchy (internal governance). Evidently one of the crucial problems to accurately and reliably measure the validity of the results is through consistent application through time. The most widely experienced measure in such analyses is the return on investment (ROI). However until now mixed results were produced. Certain specific empirical studies concluded that vertical integration affects negatively the profitability Hoskisson (1987) whereas other studies found that vertical integration may increase the return on the investment, as well as, generating more sales and profits.

The author remarks that a more in depth investigation is required on behalf of Liner operators to seek accurate feedback towards their inland investment and especially the hub terminal service which is very capital intensive. There are examples where Liner operators withdraw from loss making investments including hub terminals, e.g. Hyundai terminal investment at Pusan sold its concession to Hutchison Port Holdings. However, the initial action of Liner operators may have been activated from the market that failed to satisfy the specific requirements of the firm. This applies especially to the large firms because the cost of transacting in the free market are higher and more complex. The recent trend in merger and acquisition activity in the Liner industry accumulates more chances for greater vertical integration especially as companies target for more logistics land control.

It is noted that the governance of hierarchies produced numerous antitrust implications (Williamson (1975)). It is recognized that vertical integration if used as an offensive weapon may create oligopoly and possibly lead to high tariffs. However practice has shown that the aim is towards offering a better service and in so far is used as a defensive tool.

According to Lipczynski and Wilson (2003) no one theory yet can clearly picture the essence of what a firm is, how it acts and how it evolves. Hence, no single characteristic can lead to a general theory. Transaction-cost economics can be used as a basis for explanation of why some firms invest in inland transportation and some not, but as noted above the reasons for this behaviour are multi-dimensional.

2.9 Shippers Demand Less Transit Times

2.9.1 Transit Time Is Rated Amongst Top Criteria

The Council of Logistics Management and Transport carried a major study concerning the improvement of logistics functions (see Lambert et al. (1993) p 131). The study revealed that transportation carriers play a vital role in the overall quality of the supply chain, and that shippers set many criteria in order to evaluate and select carriers. According to the findings amongst 316 U.S.A. respondents from a wide range of manufactures, shippers attach less importance to freight as compared to other supply chain needs, e.g. faster transit times. This is because, if shippers' transportation needs are not met, then the quality of the whole supply chain can decline, thus affecting their competitive status in the market. Lambert et al. (1993) p 133 remark that carriers are penalised because of the dissatisfaction of shippers and suffer

equally heavy losses. Thus, it may be concluded from the findings that carriers need to focus on criteria set by shippers. In doing so, they not only help their shippers succeed in the marketplace, but also increase their profitability by becoming preferred carriers. In this context, carriers should consider forming strong coalitions and close partnerships with shippers and assist them plan the best transportation strategy (Lambert et al. (1993) p 140).

Brooks (2000) p 92 put forward an interesting example where St. Lawrence Coordinated Service reconfigured their service pattern in 1991 in order to offer better service to customers who experienced long transit times from Montreal to European destinations, namely Felixstowe, Le Havre, Antwerp, and Hamburg. The change in the configuration was achieved by adding another two ships (maintained weekly departure) and altering the rotation of the ships. In doing so, they reduced transit time. Consequently the service improved and was considered as a winning tool for both carrier and shippers. The element of transit time is one of the major criteria set by shippers and discussed in detail by Brooks (2000) p 64.

Interestingly, in Brooks (2000) p 64, it is questioned whether the basic carrier selection criteria have changed over the period 1982-1989. The study concerned Eastern Canadian shippers and their evaluation of ocean container carriers. The 1982 results revealed that the frequency of sailings and the freight cost of service were by far the most important criteria for selecting a carrier. Surprisingly, by 1989, the carrier selection criteria changed entirely. The sole criterion used by shippers was transit time. Even though the study offered a snapshot of the criteria during 1982-1989, it is acknowledged that perceptions over time change with market developments and the state of the economies. In addition, the findings in Brooks (1990) p 352 showed that the criterion of transit time determined the carrier to be selected by shippers in the future and not other parameters such as freight cost. McGinnis (1989) p 41

states that, according to publications distributed by the U.S. Department of Transportation, transit time was ranked more important than freight rates, and its importance was acknowledged in a total of eleven studies. Brooks (2000) points out that the supply chain processes has taken precedence over previous year's (1982) cost element. As a result it focuses on lead time (transit time). It must be stated, however, that markets are not homogeneous and different attributes may be developed in different geographical/economic areas.

In a further study, McGinnis (1990) p 16 suggests that Liner operators constantly seek service advantages over their competitors. Transit time is a major factor following the choice of mode. In Cooper et al. (1994) pp 65-66, revealed that Liner operators' selection criteria in the USA confirmed findings of previous research whereby transit time and reliability are far more important factors in carrier selection than freight.

2.9.2 Freight Costs Becomes Less Deterministic Factor

McGinnis (1990) p 17 points out that within nearly twenty years of empirical research into freight transportation, studies of various methodologies in a range of industries have revealed that, in the US, shippers, overall, value service as more important than the cost of freight transportation. In addition, he remarks that until 1980, shippers had given greater emphasis to cost whereas in the following years the element of time became significantly more important. An interesting remark by McGinnis (1990) is that freight cost service reliability and lead time was perceived differently between shippers regarding modal and carrier choice. He also points out that freight rate costs are acknowledged as important in selecting the modal transport, if the choice was amongst Liner operators (carriers), transit time and reliability

were the most important criteria following the choice of mode. However, the findings regarding shipper perceptions were consistent also in a later article discussed in Pearson & Semeijn (1998), where again US as well as European shippers considered transit time as priority and more important than freight.

According to Ballou (1999) p 106, the ultimate way to formulate logistics planning is from a profit maximization point of view. Thus, the freight element should never be a determinant factor and, in contrast, the main concern of suppliers should focus on global costing affecting the overall company Kyriazopoulos (1999) p 56.

Christopher (1998) p 95 points out that an ideal logistics-oriented costing system is intended to "focus upon the output of the distribution system, in essence the provision of customer service, and to identify the unique costs associated with that output''. Accounting methods have not succeeded in adopting this perspective and this may be one of the reasons that many customers fail to perceive the importance of the freight factor in contrast to service. However, some modern companies use a technique known as DPP (Direct Product Profitability) analysis, which attempts to identify all costs relating to a product across the distribution channel. In Cyprus for instance, most large companies have adopted these techniques, e.g. as a result, through a small research by visiting contacts, it was revealed that companies are changing their freight policy and becoming more service sensitive in terms of transit time. Thus, freight costs of 200 USD for a 40 foot container from the Far East has become a less important factor in comparison to transit time[13].

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[13] Consultation with G.A.P.Vassilopoulos Ltd

It has been observed that freight rates, especially from the Far East, fluctuate continuously in surprisingly short periods of time[14]. However, the related differences in freight charges between services via the Eastern Mediterranean hub versus the central hubs currently range between 250 and 450 USD per container[15], e.g. a 20 foot container from Hong-Kong destined to the Levant countries (Haifa-Beirut-Lattakia) via Gioia Tauro is charged approximately 350 USD less freight than via Damietta. It is the author's view that in the future an Eastern Mediterranean hub choice may offer less freight to the region compare to Gioia Tauro Provided Motherships are of similar size to the ones calling at Gioia Tauro, taking also in to account that feeder ships incur less costs due to proximity and fewer number of feeders are needed. Sutcliffe (1995). However a crucial issue that needs to be evaluated is the element of cargo volume and the container empty repositioning, both, affecting considerably the element of freight.

In Chapter 3 the author will demonstrate the accelerated historic trends of the Liner industry including strategic decisions undertaken by Liner operators and seaports.

2.9.3 Conclusion

In Chapter 2 the author opted to emphasize the importance of international logistics and supply chains. As part of a new trend, a new management system linking product material flow from source to user. This forms the basis of the thesis, since all participants in the value chain including Liner operators need to adjust to specific prerequisites set. Having reviewed the literature on logistics, it is clear that Supply Chain Management and Lead Time

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[14] Consultation with Sarlis Container Services SA
[15] Consultation with Sarlis Container Services SA

minimization are important trends of today. One aspect of greater integration, implied by Supply Chain Management is an increased emphasis on time compression. This then means that time savings are important. Time is in fact a "generalized cost" of production and distribution. It follows that Liner operators' choice of seaport hubs is crucial to their competitive position. The author wishes to correlate the strategies undertaken by Liner operators, with the prerequisites set in the value chain. Factors such as collaboration, customer service, shippers' criteria, time factor and lead time importance, as well as, the integration of transport are some of the areas where Liner operators need to focus and adjust their service strategies. As a result of this notion the author concentrates mainly in the specific area of Transit Time and seeks in the following chapters to investigate whether Liner operators' strategy to offer a service from the Far East to the Eastern Mediterranean region via centrally located hubs:

1. What are the alternative hub region options in the Mediterranean?
2. Which are the alternative candidate seaport hubs?
3. Which are the most important seaport hub criteria, considered by Liner operators and their respective ranking?
4. Which are the most suitable seaport hubs and their suitability ranking?
5. What is the transit time offered via seaport hubs in the Central and alternatively via Eastern Mediterranean seaport hubs?
6. Which seaport hub criteria, and to what extent, is transit time sensitive or robust. (What if analysis).
7. To what extent can further reductions in transit time be achieved through the choice of a suitably located seaport hub?

The last 3 points refer to a simulation analysis, see Chapter 7, with points (f) and (g) offering a "what if" possible changing scenarios. In the following Chapter 3 the author will discuss the accelerated historic developments in the Liner industry.

3. EVOLUTION IN LINER SHIPPING

In this chapter the author focuses on the accelerated historic developments in the Liner industry. The Liner industry is no exception to the trends of global evolution. Since the demand for shipping cargo is a derived demand, it needs to evolve as a part of the overall logistics supply chain, a process which involves shippers, operators and receivers. Ships have grown in size to the level of 8,400 TEUS in order to achieve economies of scale, for example a 2,000 TEUS ship accumulates a cost of 13 USD per TEU per day, where as a 6,000 TEUS ship accumulates a cost of 8 USD per TEU per day. This results from a consolidation of Liner operators through mergers, alliances, acquisitions and slot sharing agreements, e.g. Maersk acquired Sealand thus becoming by far the biggest Liner operator in the World. In addition, many Liner operators have invested in the development of dedicated terminals to handle the integration of the transfer of cargo to the inland transportation nodes e.g. Maersk Sealand in Algeciras, Hanjin in South Korea and Evergreen in Taranto. Within these integrated developments and transhipment strategies competition amongst seaports intensified. More evidently, in the transhipment hub operations, world container transhipment throughput in 2001 represented 22% (54 million TEUS) of world seaport demand and is further expanding. Apparently stevedoring costs may represent 25% of a shipping lines' main cost and to this

extent seaport hubs become more popular when they generate also large volumes of local cargoes. Aiming for success seaport hubs invest more towards becoming an integral part of a supply chain. Thus seaports do not provide only the geographical location of various activities but are considered a service center on their own.

3.1 The Shipping Industry: History and Current Trends

3.1.1 Evolution of Ship Size

According to Lowe (2002) Liners are ships plying on a regular route in accordance to a published sailing schedule. Container ship Liner services offer cargo space to all shippers who require them. They sail on specific scheduled dates irrespective of space allocation upon departure.

The first ships to utilize containers were converted, American passenger/conventional ships. Sealand first developed them in 1956 by adding special cranes. By the late 1960s, most of the major seaports started investing in containerisation since it was a rapidly expanding phenomenon all over the world. In 1968, shipping lines such as Manchester Liners and Sealand were operating gearless, and in certain cases, cellular, ships, while other carriers, such as ACL, adopted the Ro-Ro approach. This was the first ship generation of size 1100 TEU.

The second generation of containerisation began with the cooperation of OCL and ACT in the trade between UK and Australia. This was in the end of the 1970's when seaports, as well as inland facilities, were fully integrated. Ships, commonly known as the encounter bay class, were gearless cellular with a capacity of 1,200 TEU. Between 1970 and 1980 bigger ships, in the range of 2000-3000 TEU, were used in the U.S. - Europe - Middle East, and Australia - Far East trades. Apparently, the deployment of feeders during that time was in the region of 200-300 TEU capacity. The third generation ships emerged from the famous TRIO consortium, which built 18 container ships for the North Europe - Far East trade. They had a capacity of 3,000 - 4,500 TEU, a length of 900 feet, and a maximum speed of 27 knots. During the period 1980-1990 these container ships fulfilled the specification of transiting the Panama Canal locks and were worldwide recognised as the standard for deep-sea trade. They were named 'panamaxes' signifying their ability to transit the Panama Canal. The fourth generation ships were introduced in 1988-1995 following the optimisation of the 3rd generation ship to 4,000 - 5,000 TEU. The new generation of container ships emerged in 1996 with capacities between 6,400-7,500 TEU. The size of feeders today varies, depending on the trade lane, though a 1500 TEU containership may be considered the norm in much traffic around the globe. All information provided above was obtained from Tutorship (1997) and Ocean Shipping Consultants (2003) pp 34.

During 2003, with many of the major shipping lines investing in bigger tonnage, it was to be expected that 8,500-9,000 TEU ships would emerge. By 2002 the number of vessels over 6,000 TEU exceeded 60, Ocean Shipping Consultants (2003) p 33. However, the year 2001 was a landmark due to the launching by Hapag-Lloyd of the world's largest containership, with a capacity of 7500 TEU. During 2002, the largest container ship was the Sovereign Maersk 8,400 TEU Baird (2002), however during 2003 the dimensions of Anna Maersk and

Axel Maersk suggest that the actual capacity are in the region 9000 TEU, *Containerization International Year Book* (2004). Baird (2002) remarks that ships of 10-15000 TEU are expected to enter the service before 2010. Similar conclusions are given by Ocean Shipping Consultants (2003) p 33. According to Wijnolst et al. (2000) p 2, from a technical point of view, container ship size will be determined by the increase in main engine output, the dredging of the Suez Canal, the dredging of major container seaports, and the inland economics of seaport infrastructure pertaining to cost in the world economy.

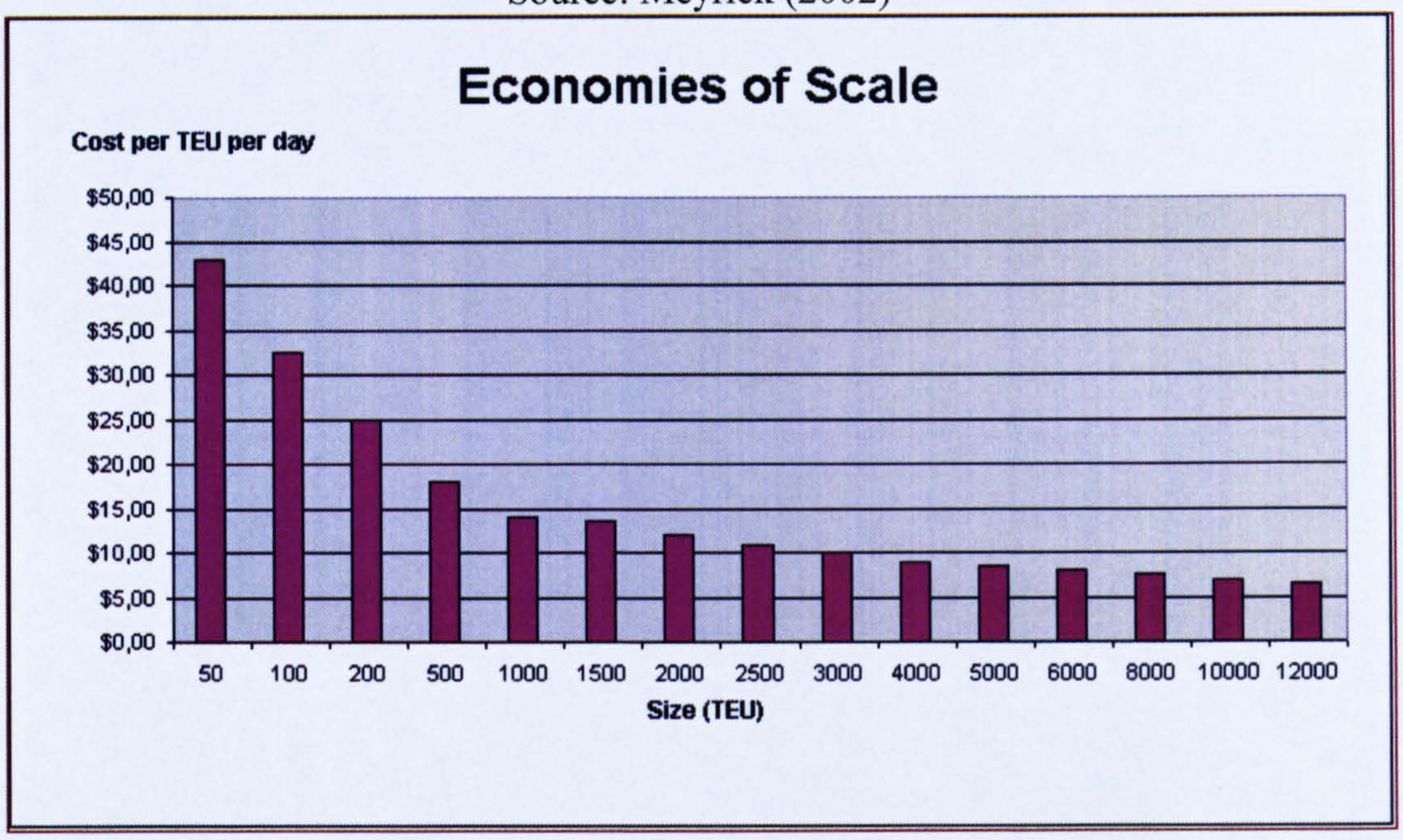
Increase in Ship Size: The Need for Economies of Scale

Progressively, over the last 10 years, a remarkable revolution has taken place in Liner shipping. More joint ventures, mega Consortia, and alliances formed by global players together with orders of 7500-8500 TEU vessels have allowed for greater economies of scale, which were previously beyond reach. Economies of scale create major advantages in any industry and shipping is no exception to this rule. Pooling resources and maximizing utilization is the ultimate objective in that any shipping line should not only rationalize but also optimise. Not only regarding the volume of traffic but also the size of ships to be employed.

Liner ships have increased in size as a means of exploiting potential economies of scale, and this has been especially apparent in the case of the world's largest volume trade routes such as East Asia-Europe, North America-Europe, and East Asia-North America. Evidently, this container traffic has been given most attention in the effort to achieve a decrease of unit costs of container carriage and invest in larger tonnage at the same time.

According to Meyrick (2002), for an equivalent deep sea voyage, large container ships provide potential cost saving, e.g. a 2000 TEU ship has an average cost of 13 USD per TEU

Figure 3:1: Economies of Scale
Source: Meyrick (2002)

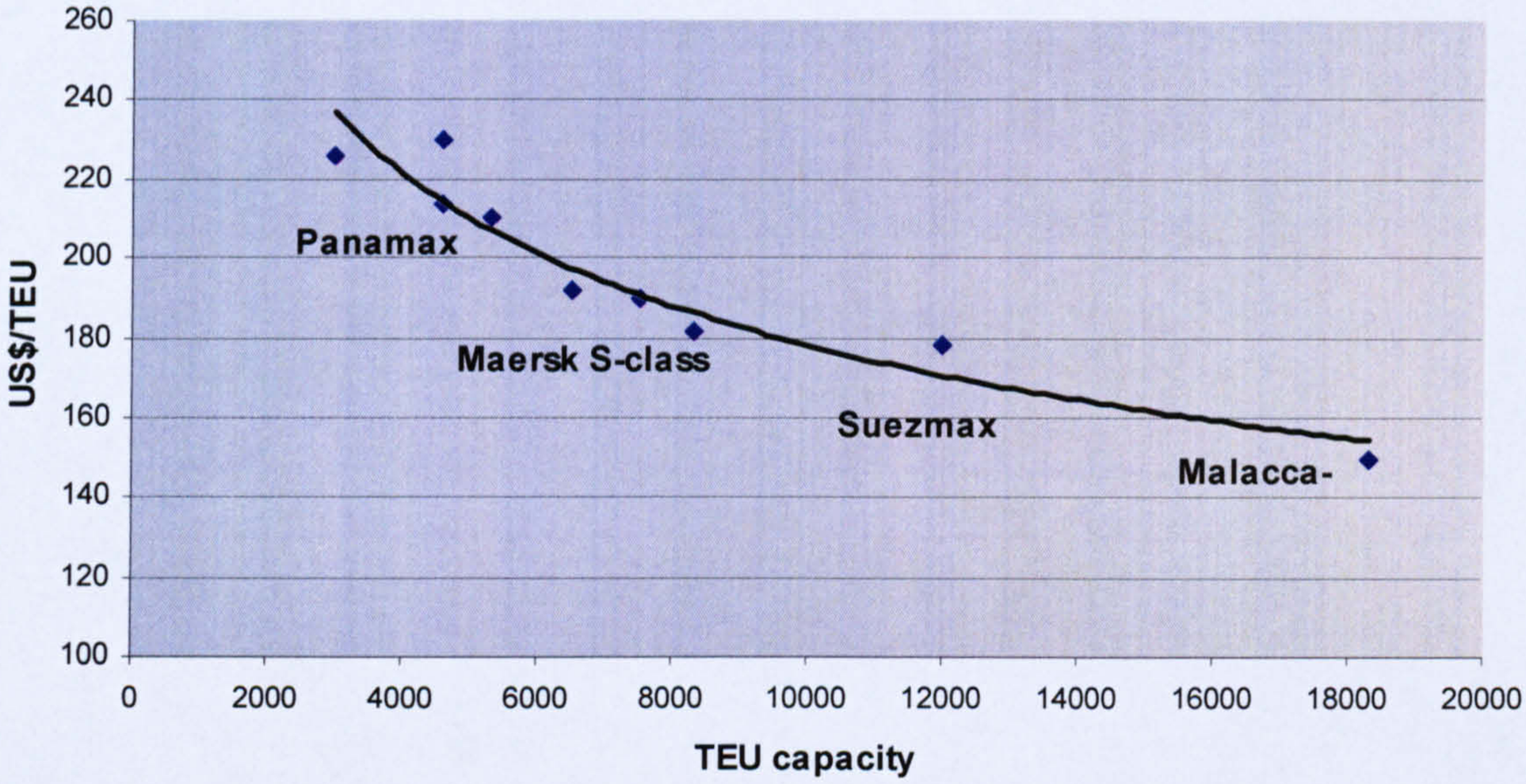


per day. In contrast, a 6000 TEU ship has an average cost just under 8 USD cost per TEU per day, as shown in Figure 3:1.

However, more economies of scale may be progressively obtained with the introduction of larger ships with a capacity of 12,000-15,000 TEU, see Figure 3:2. The viability is determined by the inland economics of the seaport infrastructure and overall cost.

Apparently, economies of scale and increase of ships size does not necessarily pertain a viable venture. It must be noted that economies of container ship voyages depend on additional factors. These include route characteristics such as prevailing current freight rates, load factors, operation in the seaports, good and bad days of the shipbuilding industry, and even accounting practices. For instance, a possibly high purchase price may be related to the vessel's extended period of life.

Figure 3:2: Economies of Scale: Transport costs between Rotterdam and Singapore
Source: Wijnolst et al. (2000) p 16



There is no doubt that shipping lines save large sums of money by seizing the best time for purchasing. Purchase prices affect competitiveness to a great extent. Furthermore, trade routes, distances, and calling seaports also affect unit costs. Nevertheless, it is generally agreed that the existence of scale economies is extremely important in container shipping though many other parameters already emphasized play a major role.

3.1.2 Liner Operators Accelerated Developments

The easy access to markets through globalisation created tremendous trade potential for shippers around the globe. Changes in the political, economic and social landscape of world trade in the past 40 years have transformed the environment of world trade. The establishment of World Trade Organization (WTO) as a successor to the General Agreement on Tariffs and Trade (GATT) on the 1st January 1995, together with the success of the

regional trading blocks such as the North American Free Trade Association (NAFTA) and the European Union (EU), has created the basis for a dramatic expansion of world trade. Furthermore, the huge advances in IT, e.g. evolution of e-commerce, e-trade, e-documentation, e-procurement and web-based logistics, further accelerated trade. These global trends have in turn created a positive chain reaction in the shipping industry.

According to Song (2003) the current business patterns of Liner operators can be summarised as follows:

- Restructuring–Rationalization and consolidation through mergers, alliances and acquisitions.
- Differentiation-introducing differentiated services part of the total logistics services door-to-door.
- Seeking greater operational coverage and scale economies-Deploying bigger motherships and expanding the transhipment strategy.

One of the main trends in the shipping industry during the mid-1990s was the establishment of global alliances, which gave an enormous boost to container ship size, Meyer (1996). This was regarded as revolutionary until the late 1980's, early 1990's. The Liner industry worked on trade lane agreements (consortia). During the late 1990s/2000s we are witnessing the phenomenon of mergers and acquisitions, e.g. Maersk acquiring Sealand and thus becoming by far the biggest Liner operator in the world. The AP Moller Group (Maersk Sealand) ranks top as regards TEU in service, number of vessels in service, as well as, TEU on order. Other Liner operators MSC, Evergreen Group, P+O Nedlloyd, and CMA CGM, rank amongst the first 5 Liner operators on the basis of TEU deployed. Evidently their investments towards new orders of vessels and TEU deployment, reveal their aggressive status in the market, see Table 3.2. Interestingly, during 2002, the top 20 operators in the Liner industry control 58 %

of the total container fleet tonnage (87% during 2003). By contrast, during the late 1980s the above figure was 37%. Furthermore, the top 20 operators' control 74% of the cellular tonnage, 73% of the new building tonnage and 100% of all post-panamax container ships, see Table 3.1. It is interesting to note that there is a considerable difference in the slots between the periods 1990 and 2000, see figure 3:3. Further, it is revealed that the move is towards large ships acquiring more slots, whereas smaller tonnage is less preferred by operators. Furthermore, concerning the new slots on order, 39% represents ships between 5000-9999 TEU, 23% ships between 4000-4999 TEU, 10% ships between 3000-3999 TEU, 16% between 2000-2999 TEU and only 9% ships between 1000-1999 TEU. The remaining 3% is between 0-999 TEU ships Meyrick (2002), see figure 3:4. According to *Containerization International Year Book* (2004) the year 2003 will go down in the history records in terms of new containers ship orders. Garcia (2004) points out that order book has reached at 610 container ships. These numbers represent a total TEU capacity of 2.4 million TEU. Almost half of these ships have been ordered during 2003. According to Boyes (2004) a substantial number of container ships are to the level of 6000 TEU. Furthermore the latter author remarks that from the 729,398 TEU ordered from October 2003 for delivery 2006 almost 50% of the total capacity relates to ships of 8000 TEU and over.

Table 3.1: Top 20 Lines
Source: Meyrick (2002)

Top 20 Lines-key statistics
58% of total container fleet tonnage
74% of cellular tonnage
73% of New building tonnage
100% of post-Panamax vessels

Table 3.2: Top 20 Container Service Operators on the Basis of TEU Deployed (October, 2003)
Source: *Containerization International Year Book* (2004)

Rank 2003 (2002)	Carrier	-TEU in service	Vessels in service	TEU on order	Vessels on order
1 (1)	AP Moller Group (1)	844,626	328	130,936	30
2 (2)	MSC	516,876	217	188,701	28
3 (4)	Evergreen Group (2)	442,310	152	132,040	18
4 (3)	P&O Nedlloyd (3)	419,527	157	113,550	25
5 (8)	CMA CGM (4)	299,174	150	120,620	19
6 (5)	Hanjin Group (5)	292,195	75	38,500	5
7 (6)	Cosco	274,128	148	62,328	10
8 (7)	APL	273,573	82	24,127	5
9 (11)	NYK (6)	233,934	91	18,714	3
10 (9)	MOL	222,533	72	28,424	5
11 (10)	CP Ships	201,706	85	38,277	9
12 (12)	K Line	186,017	63	102,244	20
13 (14)	OOCL	185,502	55	88,126	13
14 (13)	Zim	174,480	79	35,169	7
15 (16)	Hapag-Lloyd	154,850	41	50,928	7
16 (18)	Yang Ming	153,783	55	71,324	14
17 (15)	CSCL	143,655	94	121,870	17
18 (17)	Hyundai	136,548	35	38,684	6
19 (20)	CSAV Group (7)	123,378	55	94,835	20
20 (19)	PIL Group (8)	106,508	92	17,244	10
Total		5,385,303	2,126	1,516,641	271

1. *Includes Maersk Sealand, Portlink and Safmarine Container Lines NV*
2. *Includes Hatsu Marine Ltd and Lloyd Triestino de Navigazione SpA*
3. *Includes Farrell Lines Inc and Mercosul Line-Oceanica AGW*
4. *Includes ANL Container Line Pty Ltd, Feeder Associate Systems Sarl, Ybarra CGM Sud AEIE and MacAndrews & Co Ltd*
5. *Includes Senator Lines GmbH*
6. *Includes Tokyo Senpaku Kaisha Ltd*
7. *Includes Companhia Libra de Navegacao S/A, Monemar SA and Norasia Container Lines Ltd*
8. Includes Advance Container Lines (Pte) Ltd

Global alliances have been the result of client demand that has become more organized on a global scale. Kadar (1996) p 85 emphasizes that strategic global alliances were decided on a must basis with few Liner operators having no other option. The global alliances phenomenon was evident in the orders of more than 80 post-panamax vessels which have

Figure 3:3: Slots Shares 1990 and 2000
Source: Meyrick (2002)

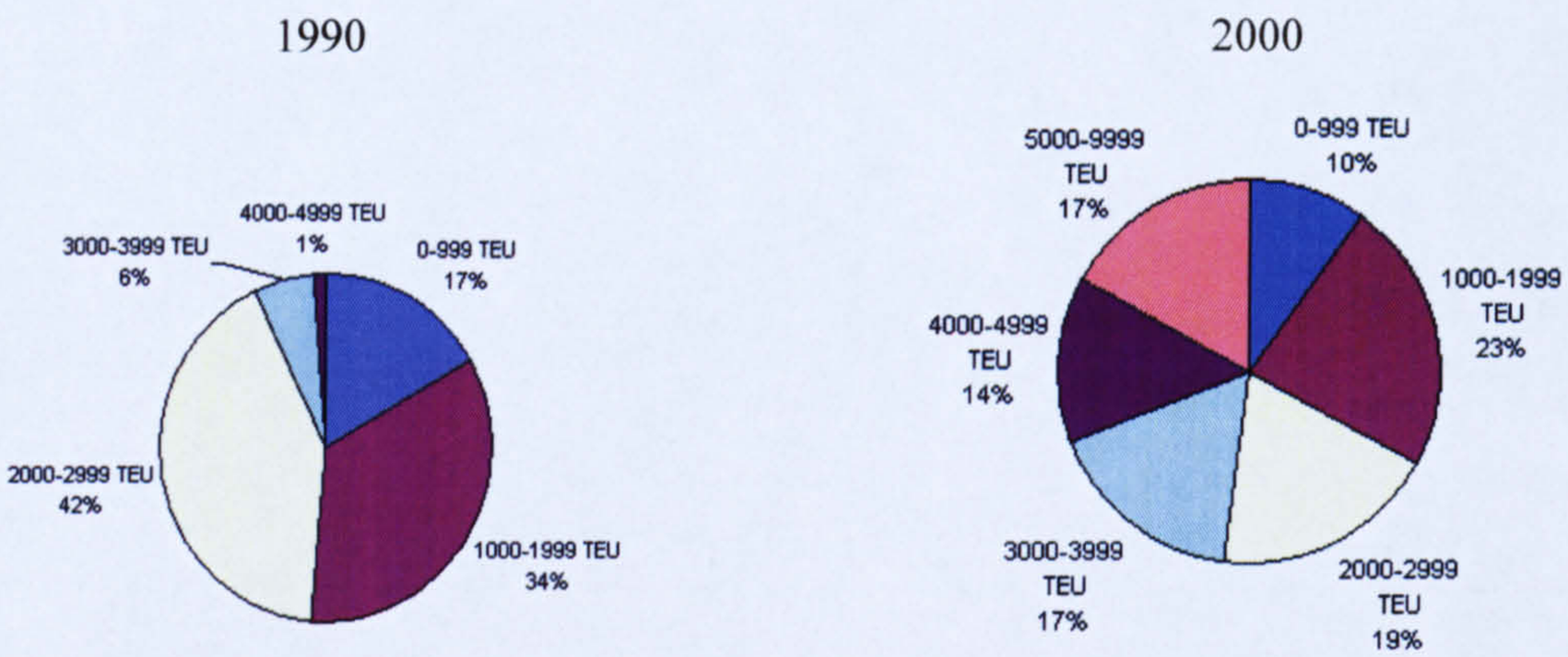
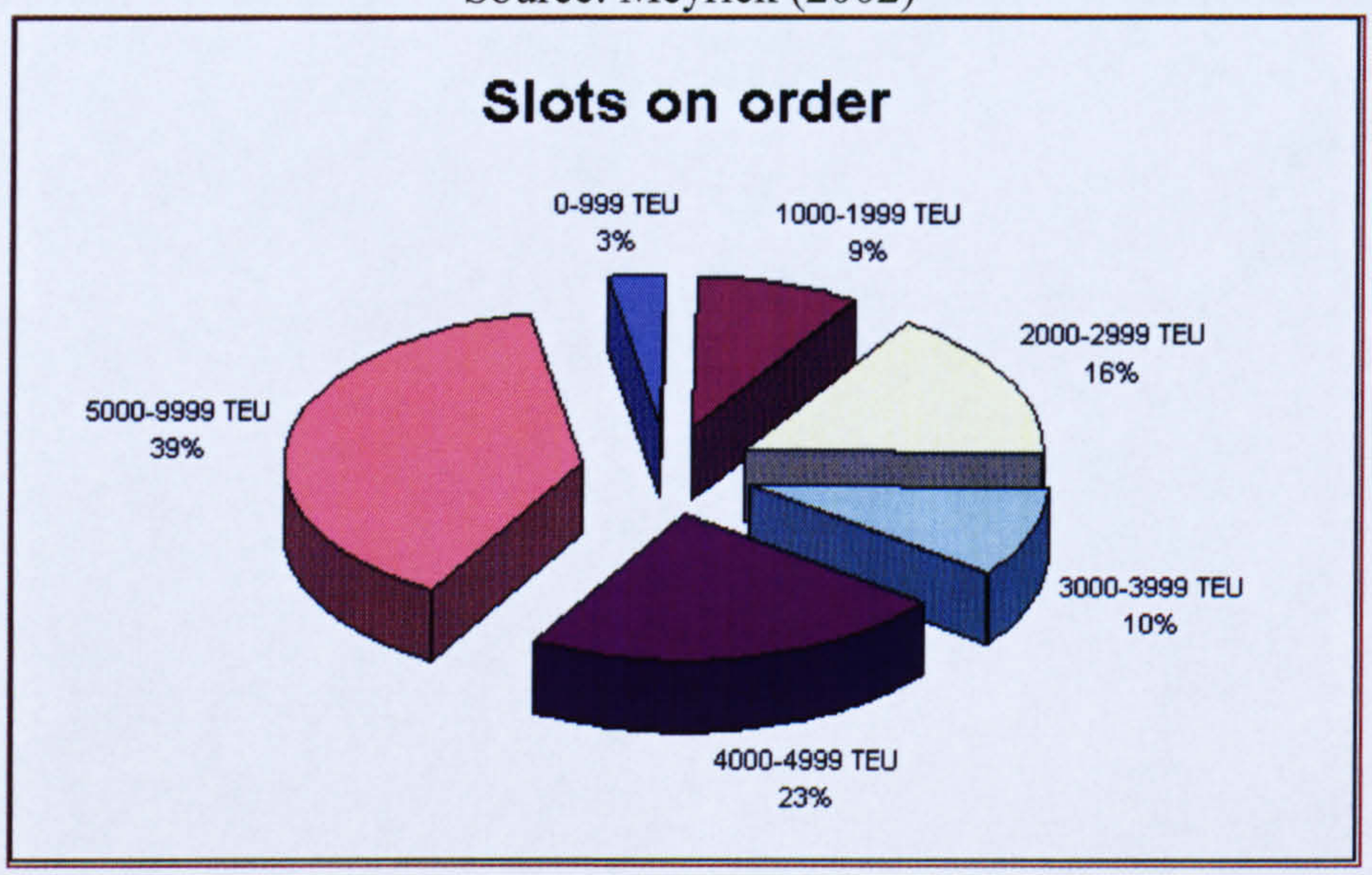


Figure 3:4: Slots on Order
Source: Meyrick (2002)



been commissioned between the period 1990-1995, Meyer (1996). Acknowledging the importance of total distribution costs and recognizing that it is not easy to maintain a frequent sailing (weekly), and at the same time keep a 6000 TEU ship at optimum capacity, carriers have compromised with the idea.

According to Midoro & Pitto (2000) the formation of global strategic alliances can achieve various objectives such as:

- *Financial Objectives: profit maximisation, increase in shareholder wealth, capital investment sharing and financial risk reduction;*
- *Economic objectives: cost reduction, economies of scale;*
- *Strategic objectives: entry in new markets, wider geographical scope, increase in purchasing power;*
- *Marketing objectives: satisfy customer requirements better, e.g. higher frequency, flexibility, reliability, network expansion (i.e. offering a greater variety of routes and destinations); and*
- *Operational objectives: increase in frequency of services, vessel planning and coordination on a global scale.*

Menachof & Damian (1998) point out that there is a differentiation of previous merger waves and current, classed as merging for strategic gain. This stems from increased competition and reduced profits which Liner operators tried to remedy amongst other through corporate synergy. As mentioned in Menachof & Damian (1998), synergy refers to the coming together of firms to produce a corporate combination which is more profitable than the sum of the individual firms profit combined. Menachof & Damian (1998) refer to two types of synergy in mergers and alliances. Operating synergy originating either from horizontal or vertical integration, cost reduction being a major source resulting from economies of scale. Accordingly mergers/alliances can cut costs by rationalization of the existing resources. Since freights over a period of time have dramatically fallen, especially in certain trade lanes the alternative solution was to reduce the cost of operation. A methodology used is the slot

chartering/vessel sharing agreements, joint terminal contracts, common use of equipment, as well as, joint purchase of equipment or even ships. The second synergy refers to the financial synergy. Furthermore Menachof & Damian (1998) point out that the risk of bankruptcy becomes less since cash flow of two companies is better combined. As a result the banks view the venture as less risky and are more willing to lend money e.g. P&O Nedlloyd secured a credit of $1 billion.

A further point raised by Menachof & Damian (1998) is the fact that entrance to new markets becomes easier where as previously considered extremely costly, e.g. (APL) American President Lines after joining with global alliance gained entry on the Europe -Far-East trade avoiding the costly element. In return, APL offered operational assets and know-how, in the US and transpacific markets. Likewise the Grand Alliance NYK&NOL slot charter on Hapag-Lloyd ships in the Atlantic traffic in exchange, Hapaq-Lloyd takes advantages of the strengths of its partners on the transpacific. Interestingly all above points relating to Mergers Acquisitions have tremendous impact also with the companies' strategic decisions in the stock market.

The situation, at the end of 2003, is that lines are organized in the following Alliances[16]:

1. "Grand Alliance" (Hapag Lloyd / NYK/ OOCL/ Nedlloyd)
2. Maersk Sealand
3. New World Alliances: APL/Hyundai/MOL
4. CHKY Alliance: COSCO / Hanjin / K-Line / Yang Ming
5. Evergreen / Hatsu marine / Lloyd Triestino

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[16] Personal consultation with GAP Vassilopoulos Ltd.

6. Hanjing/ UASC

7. Independent Carriers Alliance: CMA CGM Line / ZIM / CSAV

CMA, Evergreen, Norasia form alliances in various trade lanes with other operators.

The only loner is MSC.

Pooling fleets establishes frequency and allows them to differentiate the "product" from competing carriers. It is considered less likely for a single carrier to survive outside this concept in the long run and maintain regular weekly frequency while at the same time effectively deploying a mothership to the aforementioned full capacity.

Progressively, through the years, the globalisation of economies, liberalization and the rapid development on the east/west arterial is turning the Liner industry as global with enormous potential. Furthermore, it has become evident that shipping lines no longer see themselves as mere carriers but as logistics providers, offering added services beyond shipping a container. Panayides & Cullinane (2002) point out that ocean carriers invest in vertical integration through inland transport, terminal operations and logistics. To this extent Frankel (1999) p 10 remarks that the time when shippers used an array of freight forwarders, trackers, clearance agents, shipping companies, railways services, etc and various financial, freight insurance and other institutions are gone. According to Menachof & Damian (1998) the trend of shippers today is to associate with carriers that offer one-stop shopping for all their global shipping needs. The later authors point that such strategy can only be offered through sharing the resources and know-how by forming and joining alliances/mergers. In line with the ship's size, the emergence of global alliances and acquisitions have made the adoption of transhipment strategies a necessity. Fossey (2002), points out that relay, feeder and way seaports are emerging as a valuable strategic tool and an inevitable trend in the future.

Liner operators keep their focus on this strategy and seek opportunities in developing more transhipment alternatives with possibly dedicated tailor-made terminals, that would provide faster handling, better service, deeper water, bigger cranes, modern equipment, lower costs and various other ancillary services that would add more value to their venture; thus enhancing competitiveness. In addition a full integration of door-to-door service is observed towards supply chain prerequisites with emphasis on reliability, time compression, customization, information systems support, standardization, JIT delivery, and complete logistics network.

3.2 Seaports in the New Era

It is no longer the era where seaports existed as regional or national gateways to promote the economic development of nations. According to Finley (2002) In the last 10 years the way in which seaports have operated has changed dramatically. Seaports were once able to operate in relative isolation. Customers had little opportunity to request or negotiate services demanded. Seaports' previous trend of working on political and administrative levels had proved very ineffective. Today, service standard agreements are considered the norm rather than the exception. Becoming proactive is a key tool for seaport authorities. Overall investment decisions need to consider the size of container ships of tomorrow and many other parameters. Terminal operators at the same time anticipate further ship size increases as they place orders of gantries with 55m outreach, capable of handling 22-container wide ships. Furthermore the ambitious seaports of the new era combine economies of scale with

economies of scope[17]. Economies of scale relate to mass production and full utilization of all terminals. Through economies of scope, the seaport assumes the role of a one-stop-shop by outsourcing logistics functions and offering tailor-made packages, thus boosting added value. (Economies of scope exist if the long run average cost of producing the output jointly by one firm is less than the sum of the long run average costs of producing each output at the same level of production by two independent firms).

3.2.1 Role of Seaports in the Logistics Era

In order to adapt to increasing seaport demands and satisfy the necessities of international trade and the national economies, planners focus on a more global approach in line with operators, shippers, receivers and the world market in general. The new role of seaports stems from the production site of the raw material and being completed only after the finished product reaches the final user in the foreign country. That is why third generation seaports, and especially seaport hubs[18] of today, are no longer passive points for transport. Modern seaports play an extremely vital and active role in the world transport chain. According to Song (2003) seaports are considered a major integral part of the supply chain, forming a strategic business tool driven mainly by the private sector. Seaports play a significant role in the system, used as transport connections between sea and land, as storage and transhipment points, or as central locations in an industrial and commercial export zone. Thus, seaports do not provide only the segmented or geographical location of these activities, but are considered service centres on their own. These so-called service centres are restructuring their role within the global system.

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[17] Economies of scope: Relates to the cost savings derived from manufacturing a variety of products. In this case offering a variety of services. Dornier et al. (1998), p 252.
[18] Offers a system in transport where all cargoes are brought in to a focal point (i.e. the hub) and there onwards are distributed out in other direction., Lowe (2002).

3.2.2 Carrier Selection Criteria of Seaport hubs

Essentially, suitable seaport hubs today are focusing on seaport infrastructure and superstructure (such as numerous berths, large number and specific type of cranes) berths with sufficient draft, and accommodating yards with modern equipment. Furthermore, they are also focusing on investment in seaport service such as load and discharge speed, pick up and delivery service, electronic information availability, provision of customized service and warehousing ancillary service, etc. They also provide competitive seaport rates for the cargo operation and the mothership special tariff, Song (2002). According to Song (2002), the above areas are the target that strategically located seaports today aim at in order to attract the large operators involved in the transhipment business. Such seaports are Hong Kong, Singapore, Pusan, Kaoshiung (being the 4 largest seaports in the world, see Table 3.3), Gioia Tauro and Damietta in the Mediterranean, as well as Rotterdam and Felixstowe, in Europe.

Forming the path by which the seaport of today can encourage its customers to integrate their procedural business within the seaport system, will, to a great extent, determine their ability to make the venture viable. Liner operators nowadays select the seaport through which container cargoes will pass to reach their final destination on the basis of distribution and the whole supply chain effectiveness. Total distribution cost signifies three important elements, namely, money, time, risks. All three are calculated and compared before the selection of the best alternative seaport. Overall, the approach today is to utilize a seaport that is in line with all requirements pertaining to the acquisition of competitive advantage. According to Mercer management consultants (see Bascombe 1995) Liner operators choose seaport hubs based on a number of criteria. Some of which are: Geographic Location, Proximity, Terminal Space, Land and Sea Access, Low Cost, Capable Labour, Transhipment Capability, Understanding

Landlord, Handling of Equipment, Quick Turnaround, Feedering Connection, Labour Relations, Political Issues, Local Cargo Volumes.

However one of the major criteria discussed by Goss (1978) p 34 is efficiency, with emphasis on ship turnaround time. Goss (1978) p 34 remarks that it is gross seaport time that matters, i.e. including queuing, waiting for pilots steaming up channels, etc., in addition to time spent working on cargo.

Beyond the traditional key success factors such as efficiency, reliability and speed, a seaport hub needs to introduce new key success factors: added value responsiveness, global service offering, flexibility, transparency and integration. Seaport hubs today adapt to a new set of status offering, beyond operational excellence and cost leadership, the element of added value to the global network of shipping services.

3.2.3 Seaport Competition New Developments

In the last few years, the Liner industry has witnessed a phenomenon where operators wish to control their service excellence. A number of owned or joint-venture terminals have been established by Liner operators, such as Maersk Sealand at Algeciras, Evergreen at Taranto, Hanjin in South Korea and many others in other strategic parts of the world, Ocean Shipping Consultants (2003) pp 35-37.

The idea stems from the change towards larger vessels driving Liner operators to gain full control by integrating stevedoring and mother/feeders ship schedule. It is assumed that dedicated terminals are more efficient and cost-effective though too capital intensive for

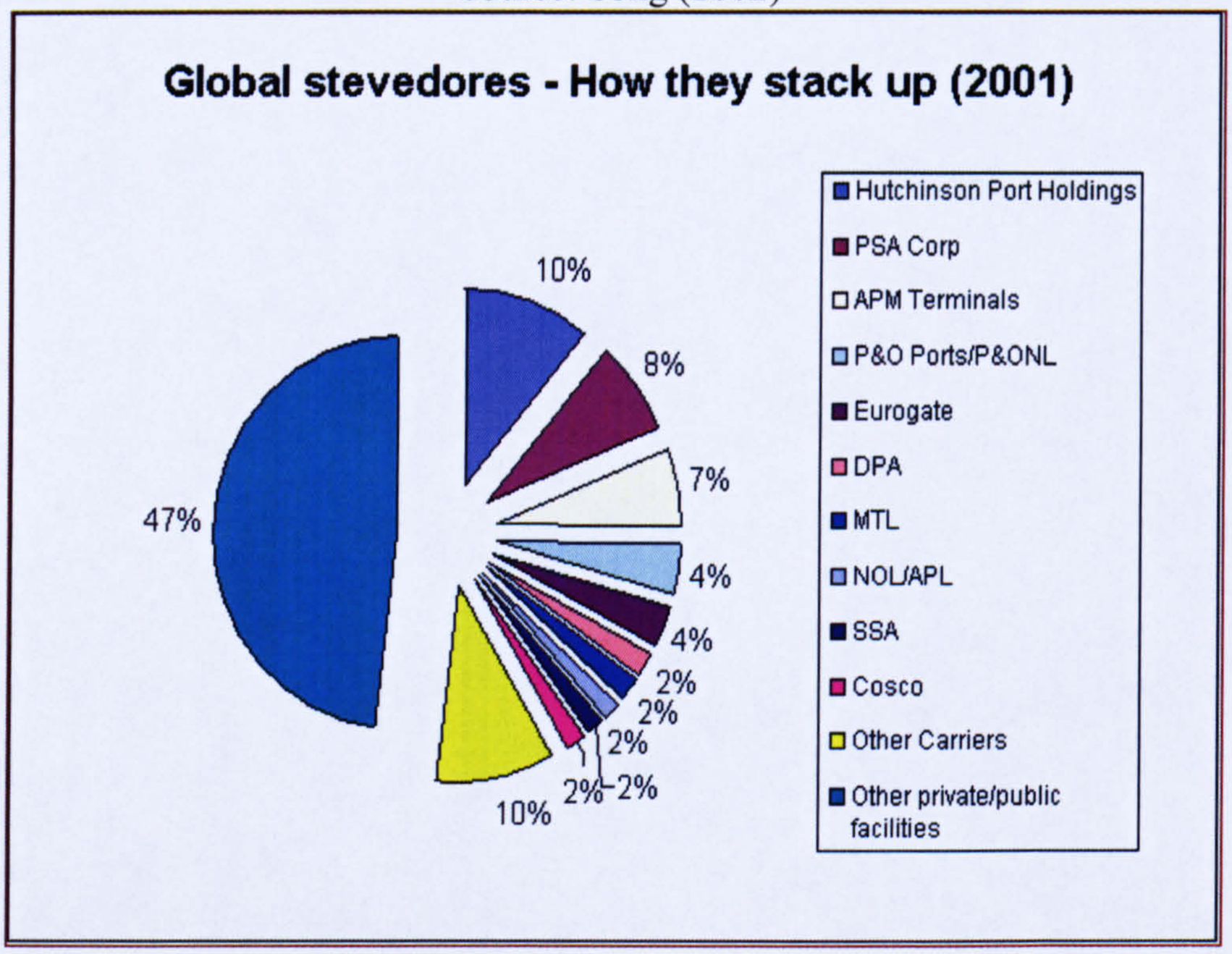
Liner operators to invest in, Ocean Shipping Consultants (2003) pp 38. Apparently according to Ocean Shipping Consultants (2003) p 38, the over-ordering of new tonnage, causing several effects on profitability, reduced the investment in container terminals. Some Liner operators were unable to forecast or adjust to market changes and sold their venture stake, e.g. in Korea not surprisingly, Hyundai sold its concession to Hutchison Seaports at Pusan. It is noted that Terminal Management Business i.e. Hutchison Port Holdings is a different development. According to Heaver (2004) companies such as Hutchison Port Holdings, the port of Singapore Authority and P & O ports are utilizing their expertise knowledge including integrated information systems to promote a global business. The terminals do not sell directly their services to shippers, but focus on liner operators being their sole customers. Hutchison Seaports claims to be the leading global container stevedore, handling in 2001 approximately 27 million TEU at 30 seaports (Ocean Shipping Consultants (2003) pp 35). Another major operator is APM, the parent company of Maersk Sealand, considered the largest containership operator in the world. APM, with 30 terminals around the globe, is the third largest terminal operator in the world moving over 15 million TEU annually (Ocean Shipping Consultants (2003)) p 35, see figure 3:5. Although this venture was set up to service the Maersk Sealand stevedore operations, the rationale today is to offer their services to third-party carriers. Such strategic moves introduced by Liner operators address further fierce competition amongst seaports. In fact, seaport operators today move aggressively to reach out to potential customers, offering them tailor-made packages that are in line with their overall supply chain. One such example is the seaport of Palepas, which from a mere volume of 432,000 TEU until 2000, reached more than 2 million TEU in 2001 Ocean Shipping Consultants (2003), after securing two major shipping lines, namely, Maersk Sealand and Evergreen, through equity participation and contractual arrangements.

Table 3.3: Seaport Traffic League in 2002
Source: Containerization International Year Book (2004)

Rank	Port Name	2002 TEU	2001 TEU	Rank	Country
1	Hong Kong	19,140,000	17,900,000	1	China
2	Singapore	16,800,000	15,520,000	2	Singapore
3	Busan	9,436,307	8,072,814	3	South Korea
4	Shanghai	8,610,000	6,340,000	5	China
5	Kaohsiung	8,493,000	7,540,524	4	Taiwan
6	Shenzen	7,613,754	5,076,435	8	China
7	Rotterdam	6,515,449	6,102,000	6	Netherlands
8	Los Angeles	6,105,863	5,183,520	7	USA
9	Hamburg	5,373,999	4,688,669	9	Germany
10	Antwerp	4,777,387	4,218,176	11	Belgium
11	Port Klang	4,533,212	3,759,512	12	Malaysia
12	Long Beach	4,526,365	4,462,971	10	USA
13	Dubai	4,194,264	3,501,820	13	UAE
14	Yantian	4,181,478	2,700,000	17	China
15	New York/New Jersey	3,749,014	3,316,276	14	USA
16	Qingdao	3,410,000	2,640,000	18	China
17	Bremen/Bremerhaven	3,031,587	2,972,882	15	Germany
18	Gioia Tauro	2,954,571	2,488,332	20	Italy
19	Felixstowe	2,750,000	2,800,000	16	UK
20	Tokyo	2,712,348	2,535,841	19	Japan

However, given the uncertainty of future business from Liner operators and further consolidation within the industry, seaport operators are devoting much attention to building strategic collaborations not just with their customers but even with their competitors. Towards this notion Song (2003) introduced the term co-opetition as a new strategic approach by seaport operators in order to strengthen their positions and enhance their market power. Seaport operators through equity joint ventures and collaboration increase their market power. The term co-operation and competition (co-opetition) can be applied since seaports in a region are competing against each other, but at the same time by working in a co-operative form can boost mutual benefit. For example Hong Kong seaport operators such as HPH (Hutchison Port Holdings) is in competition with Yantian seaport (Mainland China) though at the same time co-operation exists through Hutchison Port Holdings, Groups

Figure 3:5: Global stevedores-How they stack up
Source: Song (2002)



common ownership at Yantian seaport. Similar joint ventures apply amongst Shekou, Chiwan (China) seaport operators with other Hong Kong seaport operators, e.g. COSCO and Modern Terminals Ltd (MTL), Song (2003).

3.3 Transhipment Becomes a Global Strategy

"The term 'transhipment' will be used here in its dictionary sense to mean the transfer of goods, in this case a container, from one ship to another. The operation generally includes some period during which the container is kept in the yards of the seaport where it has been unloaded. It is very unusual to have a situation in which the container can be transhipped directly from one ship to another or to a barge, UNCTAD (1990) p 7.

Overall, the main advantages of a transhipment strategy can be considered to be the following (Hunter (1996)):

- Bigger vessels are being introduced achieving economies of scale.
- Motherships call at fewer seaports, thus making more voyages per year resulting in greater cargo volumes and less costs.
- Global carriers are in a position to exercise increasing leverage on seaport hubs, thus reducing costs.
- More seaports can be served (feeders).
- Transhipment strategy initiated the involvement of carriers in the participation of seaport operations.
- Through cargo on main line ships has faster transit.
- Main line itineraries and schedules are followed more reliably when there are fewer calls at seaports.
- The stowage plan is more convenient with less seaport calls.
- Higher volumes can be expected through additional traffic.

The following can be considered to be the main disadvantages of transhipment (Hunter (1996)):

- The double handling of containers increases costs if not evaluated and optimised correctly.
- Service to the feedered seaports becomes less reliable especially in the case of longer distances.
- Additional ships are needed to service through feeders.

Types of transhipment

According to UNCTAD (1990) there are four main types of transhipment: The first is scattering feedering transhipment (more commonly known as hub and spoke); it is the most common form whereby the mother vessel calls at a particular seaport hub and all regional seaports are served through feeders. This type relates to the topic investigated in this thesis.

The second is inter-line transhipment (relay). In this case, a mothership intersects at a particular seaport hub with another, either mother or feeder ship, at a predetermined time. This type of transhipment offers extended service coverage, such as linking East-West services with North-South services. The seaport hub chosen might not necessarily be a load centre. The intersection of two motherships usually results in costly delays at the seaport.

The third type is switching transhipment. Situations do arise where certain segments of regional seaports do not have the necessary volumes for direct service. In this case, shipping carriers utilize two or even three transhipments to serve them. Eastern or western African seaports are examples of this in cases of cargoes originating from transatlantic regions calling at continental Europe and subsequently on to feeders.

Another type of transhipment relates to service a region through sea and land rather than through feedering. Maersk Sealand lines are currently using the famous double stack block trains to service the eastern and western coast of the United States. Additional regions, which are well served by land bridge, are Central Europe, usually through the continent, and the Middle East countries sometimes through eastern Mediterranean seaports. In such cases, containers are being discharged at the seaports and thereafter loaded through inland transportation to the place of destination. Rotterdam is a prime example for the continental

trades as well as Haifa, Lattakia, and Beirut for the Middle East routes. The TransSiberian railway is a further example of a case where cargoes originating from Asia or Eastern Russia can be shipped through Europe via inland transport.

3.4 Transhipment Promotes a Global Synergy

Only in the last 10 years has there been a more eager and positive approach towards transhipment due to the successful "made-to-measure" service provided by the carriers. Apparently, from 2002, 25-27% of all containerised cargo now relates to transhipment and the number is expected to double between 1999-2010, Fossey (2002). Furthermore, world container transhipment throughput in 2001 was estimated to be 55 million TEU, representing 22% of world seaport demand from 1995-2001. However, 58% of the transhipment throughput was located in East Asia where Singapore dominated by handling 30% of total volume (Ocean Shipping Consultants (2003) p 43).

Transhipment promotes a global synergy of participation from seaports, agents, and ship operators. Even though it was mainline carriers who initially adopted this strategic formula, it was subsequently adopted by the majority of shippers and receivers. Nowadays, through technological evolution and logistics integration, global carriers are seeking to accumulate more benefits. Transhipment today is regarded as a valuable tool in boosting competitiveness. An overall greater quality ratio and economies of scale, together with efficiency in trade integration, lesser costs and better reliability, have all been made possible through the adoption of transhipment strategies. However it is the authors view that where local seaport volumes increase substantially, then possible multiple direct seaport calls may be justified. In such cases better transit time can be achieved, as well as, saving the double handling and

deployment of extra feederships; though such possibility may not be applicable to the Eastern Mediterranean considering current volumes. Contrary the transhipment strategy is being adopted by all Liner operators serving this market.

Overall planning and (logistics) coordination should reflect shipper/consignee expectations in terms of total distribution cost; otherwise, the whole service may collapse. Taking into account flexibility, pricing, regularity, economies of scale, viability and seaport technology, the carrier's objective to deliver the goods must be in line with the receiver's needs in terms of money, time, and risk. An indicative example is the service from N. Europe to Sudan offered by CMA (Whitelaw (2002)). The options to be chosen are fortnightly direct service or departures two times a week via Jeddah, being used as a hub, with fixed day weekly relay to Seaport Sudan. CMA Lines offers this service and their overall hub choice round the globe is Malta for the Mediterranean, Khor Fakkan for the Arabian Gulf, and Seaport Keelung in South East Asia. In addition, the line serves Damietta-Jeddah for the Red Sea. According to CMA officials, hubbing and transhipment is the only viable strategy today. Their new vessels of size 6,500 TEU produced far better results by cutting the round voyage duration from 63 days to 56 days. This way utilizing one less vessel and offering a weekly service.

However, transhipment is considered common in the trading patterns of industrial nations. It usually takes place between two deep-sea voyages like U.S.-Europe, Far East-Europe, Europe-West Africa, U.S.-Far East-Mediterranean etc. The common practice involves one long haul and a shorter feeder service, e.g., U.S.-Continent and Continent-U.K. or Scandinavia, Far East-Mediterranean and the East-Central-West- Mediterranean seaports.

The whole operation provides flexibility together with productivity and economies of scale. This is made possible by innovations in ship design, which are aimed at promoting a made-to-measure service from the carrier towards the shipper/consignee. Furthermore, specific costs of operating the mothership allow for fewer seaport calls, which result in traffic density, which is further translated into substantial reductions in waiting time.

Today's shipping carriers have organized their logistics based on the adoption of a series of transhipment strategies. However, a crucial issue to note is that transhipment may become costly unless rates of stevedoring costs are negotiated properly. Stevedoring costs may represent 25% of a shipping line's main costs, Milliken (2002). This focal point is a possible future rationale in explaining why containerships may not become enormously larger to the extent where stevedoring costs would be prorated detrimental, i.e., when a 10,000 TEU ship transhipps at a hub approximately 7000 TEU, then the stevedoring costs may be extremely high, Wijnolst et al. (2000) p 18 point out that at least 35-45% of the total containers should remain in the main seaport, otherwise the additional transport costs outweigh the economics of ultra large container carrier (at sea and in seaport). According to Baird (2002) the expected future development of transhipment will be dependent on several interrelated functions such as:

- Further increase in vessel size and moves to reduce the number of seaport calls in a given region;
- Port and terminal accessibility for the largest classes of vessels;
- Operating costs for direct call versus transhipment;
- Availability of capacity for transhipment operations, as determined by the local balance of supply and demand in a particular seaport market;

- Shipping line investment in dedicated terminals - with this effectively locking a line into a particular seaport;
- Development of relay operations linking deep-sea services at a particular terminal;
- Development of new 'offshore' hubs offering attractive packages for carriers;

In the following chapter the author will focus on the Eastern Mediterranean seaports market potential and further discuss the decisions undertaken by certain Liner operators to choose centrally located seaport hubs for cargoes originating from the Far East destined to the Eastern Mediterranean. Furthermore, some practical examples affecting the centrally located seaport hubs are presented.

4. THE EASTERN MEDITERRANEAN SEAPORTS MARKET

It has been witnessed that during the period 1995-1997 major Liner operators, e.g. CMA, Evergreen, COSCO, DSR senator, decided to shift their transhipment hub operations from the Eastern Mediterranean to Centrally located Mediterranean seaport hubs. Furthermore other joint alliances offered a service from the Far East towards the Eastern Mediterranean region via centrally located hubs (containers originating from the Far East destined to the Eastern Mediterranean region). However feedback from suppliers and consignees was negative due to prolonged transit times, sometimes up to 40 days (Levant countries and Cyprus).

In this chapter it is proposed that the Mediterranean be segmented into three regions, West, Central, and Eastern, so that Intra Mediterranean competition between Mediterranean seaports can be analysed. A description of the key seaports in the Eastern and Central regions of the Mediterranean is also provided. In 1996 six seaports in the Eastern Mediterranean handled 100% of the transhipment volumes in the region and are in competition with

Centrally located hubs namely Gioia Tauro, Marsaxlokk, and Taranto (containers originating from the Far East destined to the Eastern Mediterranean). Hunter (1996)

The author will initially seek a comparison tool amongst the two regional seaports based on centrality and intermediacy. The author will further point that due to the large distance amongst the geographic regions, this element correlate to the overall transit time. In addition since all the cargo that is destined to the Eastern Mediterranean is transhipped, the average cargo transit time is likely to be lower if an Eastern Mediterranean hub is to be chosen. The term "To-and-from" is proposed by the author to form the basis of the Average Cargo Transit Time (ACTT) in Chapter 7.

Furthermore, the author discusses the overall growth and potential of the Eastern Mediterranean in relation to the expansion of world container traffic, especially that originating in the Far East. A further point to be raised by the author is that Gioia Tauro and Marsaxlokk face periodical congestion problems. However since 2002 several Lines changed their Far East-Eastern Mediterranean container service from centrally located hubs towards Eastern Mediterranean regional hubs, namely, Hapag Lloyd, Yang Ming, CMA CGM, In addition Maersk Sealand is said to start operations at Suez Canal Container Terminal, expected to be completed during late 2004. A last point to be discussed is a recommendation referring to the article of Zohil & Prijon (1999). The author remarks that Zohil & Prijon (1999) possibly neglect the forces of supply chain as well as the element of ACTT affecting possibly the hub popularity.

4.1 An Overview of the Mediterranean Seaports Market

A prominent characteristic of the Mediterranean is the considerable distances between its seaports. The distance from Algeciras (Gibraltar) in the West, to Beirut in the East, is over 2,000 (n. miles). This has led the author to suggest the segmentation of the Mediterranean into three distinct peripheral seaport regions, namely the Eastern, Central and the Western. This is justified by the fact that most large container operators utilise two or even three Mediterranean hubs[19]. Furthermore, this segmentation approach in three distinct peripherals is also employed in Ocean Shipping Consultants (2003).

The main commercial seaports within the Eastern Mediterranean include Piraeus in Greece, Izmir and Mersin in Turkey, Limassol in Cyprus, Lattakia in Syria, Beirut in Lebanon, Haifa and Ashdod in Israel as well as Damietta, Port Said and Alexandria in Egypt. Characteristics and facilities of these seaports vary greatly amongst them, some of which posses major advantages towards others, signifying their ability to perform better as seaport hub candidates. The seaports Ambarli (Turkey) and Thessaloniki (Greece) although produce significant volumes of TEU(815000 TEU and 270000 TEU respectively) are not included in the analysis since are considered primarily seaports serving the local and the Balkan market.

Statistics for the years 1995-2001 provide some interesting information, Ocean Shipping Consultants (2003) p 175. Container throughput for the entire Eastern Mediterranean increased by 63% over that period, (including the Black Sea) with an estimated increase of 4.2% occurring in 2002. Note that total throughput amounted to approximately 7 million

[19] Personal consultation with Hapag-Lloyd.

TEU. The overall container throughput is steadily increasing, with Turkey and Egypt being the leading nations.

During 1994 six Eastern Mediterranean seaports handled the entire transhipment business (approximately 900.000 TEU), according to Sutcliffe (1996). These transhipment seaports were Piraeus, Alexandria, Damietta, Port Said, Limassol and Haifa. During 2001, four seaports, namely, Damietta, Piraeus, Limassol and Port Said, handled in total 1,248 million TEU as transhipment, Ocean Shipping Consultants (2003) p 149.

Given that these seaports possessed at least medium to high hub role potential and/or load centre potential, Hunter (1996), the present study concentrates on them as the most likely hub candidates in the Eastern Mediterranean. These six seaports are in strong competition, as each possesses unique characteristics and is chosen by Liner operators on different grounds. In the case of West Mediterranean seaports, the majority of transit containers are handled by only three seaports, namely Algeciras, Valencia, and Barcelona. At the centre of the Mediterranean, Gioia Tauro became the busiest seaport in the Mediterranean in 2000 with 2.6 million containers per year, Ocean Shipping Consultants (2003) p 173. Three seaports in the Central region of the Mediterranean, namely, Gioia Tauro, Marsaxlokk and Taranto handled a total throughput volume of approximately 4,688 million TEU in 2002. Gioia Tauro became the busiest seaport in the Mediterranean in 2000 with a throughput of 2.6 million TEU in the year, (Ocean Shipping Consultants (2003) p 173-174).

However, at the time of the study (1996-2004) none of the Mediterranean basin seaports could act as a single Mediterranean hub due to the lack of the necessary ancillary and operational infrastructure, but most importantly due to the proximity (distance from the hub

seaports, to the destined seaports). Furthermore, Mediterranean traffic volumes (approximately 22 million TEU), imply not few but more alternative seaport gateways, (Ocean Shipping Consultants (2003) pp 171-176).

Yet, certain hubs can serve as peripheral regional hubs for the Eastern Mediterranean. Thus, if the Western, Central and Eastern Mediterranean regions are compared in terms of the benefits they offer to shipping lines today, the following findings emerge. Eastern Mediterranean seaports are advantageously located for the Far East trade and Western Mediterranean seaports are better located for the US trade. Moreover, seaports that offer no deviation on the Suez- Gibraltar axis are favoured for interlinking deep sea services, e.g., Damietta, Port Said, Marsaxlokk, Algeciras, etc.

The author claims that the Eastern Mediterranean potential is further strengthened with the emerging market of the Black Sea, and in general the continuous expansion of the Eastern Mediterranean market, see Section 4.7.1. In addition, if Iraq and the Arab-Israel problem reach a solution, further expansion will accelerate. Turkey, as well, has a great potential and may acquire a further role in acting as a gateway to the Arab interior.

The Eastern Mediterranean trade originates mainly from Northern Europe, Intra-Mediterranean, Far East trades, and the USA. It is important to note that all these trades are steadily growing. The fastest growing market is with the Far East with an increase of 25% in 2003, while with the European traffic there is an increase of 10% in 2003, Woodbridge (2004). Interestingly, an expanding market is the Black-Sea from the Far East, which can easily be served via Eastern Mediterranean seaports.

The, regional seaports of the Eastern Mediterranean have no history of providing extensive supply chain ancillary services as have emerged in Hong Kong, Singapore and Kaohsiung. During the 1990's progress has been more than evident, mainly due to the Far East-Mediterranean transit traffic. However, Liner operators such as COSCO, Norasia, CMA, Evergreen - Lloyd Triestino, Yang Ming, Grand Alliance (some members), TRICON Consortia, New World Alliance (some members) are some of the large operators that once utilized extensively the Eastern Mediterranean seaport hubs, Ocean Shipping Consultants (2003) p 175. Comparing the time period from 1996 (when the author made his field trip to these seaports) and 2001, surprisingly, few Liner operators utilized these hubs for transhipment as before. Although competition amongst the Eastern Mediterranean seaports has been fierce, the alternative gateways that swiftly attracted most of the Liner operators were Gioia Tauro, Marsaxlokk, and Taranto, all situated at the very centre of the Mediterranean. Some of the first lines that showed interest during 1996 to utilize centrally located hubs, namely Gioia Tauro, were Maersk Sealand (prior to merger) Contship Italia, Evergreen, Norasia and Tricon, King (1996) pp T4-T5

All the above validate the argument that centrally located seaport hubs are in competition with Eastern Mediterranean seaport hubs. Some of the big Liner operators have implemented the idea of utilising a central seaport hub as a main gateway for their cargoes destined to the East and Centre of the Mediterranean. Even for cargoes originating from the Far East, via the Suez, the aim was to tranship through centrally located hubs, e.g. Gioia Tauro. According to King (1996) p T5, during 1996, the Mediterranean seaport industry lived under the shadows of the possibility of shipping lines to consolidate seaport calls in one single super hub, e.g. Gioia Tauro. As a result competition amongst Eastern Mediterranean hubs grew further, originating mostly from centrally located hubs.

The author takes into account this strategic reality encountered by many large carriers and questions the long run viability and effectiveness of this service, putting emphasis on the transit time element affecting the overall supply chain. In fact, it was apparent that customers in the Eastern Mediterranean region experience prolonged transit delays[20]. For this the author will work on a specific analysis through a simulation model (Chapter 7). Further, the author considers that a more in depth analysis of these seaports is required. This is carried out in Section 4.2.

4.2 Central Mediterranean Seaport Hubs That Serve the Eastern Mediterranean

The following provides a brief description of the important regional country seaports in the Central Mediterranean (being in competition with Eastern Mediterranean seaport hubs) See, also the characteristics and facilities of the seaports in Appendices III-XVI.

4.2.1 Gioia Tauro seaport: Italy

The seaport of Gioia Tauro, situated at the centre of the Mediterranean, approximately 950 miles from Suez, 1030 miles from the Levant countries, is in actual competition with the regional hubs of the Eastern Mediterranean. It is a new seaport that became operational in 1995 with major funds from the Ravano family, owners of Contship Italia and currently a subsidiary of German companies Eurogate and Eurokai. During 2003 the seaport handled 3 million TEU (95% in transhipment) superseding Algeciras record of 2 million TEU in 2000.

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[20] Personal consultation with GAP Vassilopoulos Ltd.

It is considered the busiest seaport in the Mediterranean today, Ocean Shipping Consultants (2003) p 174.

The ambition of the main terminal, called Med Center is to act as a centralized transhipment hub for the whole of the Mediterranean and further boost the development of the inland distribution towards Europe. Today approximately 26 per cent of the total transshipment is routed to the Eastern Mediterranean/Black, Woodbridge (2004).

No doubt, this private seaport has many advantages and, in comparison, many of the Mediterranean seaports would envy it. This, together with the abundance of space and production guarantees for motherships, attracted the major carriers.

Some of the major Lines that use this seaport during 2002-2003 include Contship, New World Alliance, Grand Alliance, Evergreen, Maersk Sealand, Safmarine, Norasia, Senator and many other, as well as, most feeder operators. Although this seaport claims to be state of the art, several problems emerged during 2002-2003 mainly in relation to congestion. The large volumes of containers encountered by the motherships experienced smooth operations. However, feeders, due to large numbers, could not be accommodated all at once and on time. Experience shows that feeders periodically took up to 4 days to enter the seaport due to congestion[21]. In fact during 2002, these severe delays forced the New World Alliance and Grand Alliance to switch temporarily to Cagliari. It is noted that such delays may have negative repercussions to the supply chain lead time. The problem is further magnified when

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[21] Personal consultation with GAP Vassilopoulos Ltd (2003).

products originating from the Far East destined to the Eastern Mediterranean suffer additional delays due to distance proximity.

For all characteristics and facilities, see Appendix III.

4.2.2 Marsaxlokk seaport: Malta

Marsaxlokk is situated at the centre of the Mediterranean approx 1,030 miles from the Levant countries and very near to Gioia Tauro and Taranto seaports. It is considered a major transhipment hub, having handled almost 1,3 million TEU in 2003 (Containerization International Year Book (2004)). One of the prime advantages is the zero deviation (just 6 miles) offered to the motherships on the Suez-Gibraltar axis. In addition, there are many integrated logistics services as well as modern EDI facilities. Its logistics chain facility "Distripark" links global warehousing within a free zone environment, thus enhancing worldwide connections.

However, the seaport lost its good image on several occasions due to congestion problems and only recently (2003) regained its credibility[22]. The officials worked very hard towards dealing with this issue through further expansion - improving equipment facilities and promotion campaigns. It must be noted that heavy losses were incurred as many lines switched to other hubs. The Grand Alliances and the New World Alliance have shifted to Gioia Tauro. Some of the large operators using the seaport are CMA CGM, Maersk Sealand, Norasia, K-Line, MISC, Hapag-Lloyd, NYK and OOCL.

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[22] Personal consultation with CMA CGM (2003).

Future Plans: Freeport will increase its current annual capacity to 1.75 million TEU through further development of land and equipment. An additional 1,246 container ground slots will be added by further development of the Terminal One yard and the hinterland. This development will boost the total number of container grounds slots on the Terminals to 12,080 TEU.

Malta Freeport is also developing a new Main Gate. Two different areas will be designated close to the Main Gate, one for the implementation of a fixed vehicle and cargo inspection system and the other of the installation of a border inspection post which will have both veterinary as well as phytosanitary laboratory facilities. Freeport will be developing further the Terminal One yard and the hinterland to create an additional 2,034 container ground slots. The Terminal's facilities will be enhanced with investment in additional quayside and yard equipment as well as refurbishing of existing ones.

Additionally, the Company also has the required land available for the further development of its distripark facilities.

For all characteristics and facilities, see Appendix IV.

4.2.3 Taranto Seaport: Italy

Taranto seaport is situated on the northern coast of Italy at the Gulf of Taranto. Its distance from the Levant countries is approximately 1,030 miles. It is 950 miles from Suez and is regarded a promising centralized hub. The role of the seaport changed considerably with the opening of its container terminal. Recent studies by seaport officials reveal that, by 2010, the

seaport, as a transhipment hub, can claim a share between 14 % and 35 % of the whole Mediterranean market.

In line with Taranto's ambitions to further exploit the container potential and inter-modal logistics chain, it is looking forward to upgrade internal and external road networks. In terms of long distance transport, an important link to the seaport is provided by the A14 Adriatic motorway. This, in effect, further upgrades the seaport's importance as a gateway to the North of Italy as well as the European market. Since 2001, the seaport Authority has granted a concession to Evergreen to utilize the new container terminal. Apparently, the entire Eastern Mediterranean region is served, in terms of cargoes originating from the Far East, through this seaport hub.

For all characteristics and facilities, see Appendix V.

4.3 Eastern Mediterranean Seaport Characteristics and Facilities

The following provides a brief description of some of the Eastern Mediterranean seaports. Evidently, the older seaports of the Eastern Mediterranean are highly constrained in terms of space. It is acknowledged that Alexandria, Port Said and Beirut are restricted in carrying out their operations smoothly. Furthermore, the Syrian seaports are lacking infrastructure, which is also true of Beirut where large volumes of containers were emptied in the seaport, (Hunter 1996).

The more recently developed seaports possess different characteristics as they are situated away from city centres. Conventional cargo is very limited especially in the Egyptian seaport of Damietta, as well as in Piraeus and Haifa. Furthermore, the author noticed during his field trip that modern terminals were designed around fewer but longer quays thus provide no more flexibility for container operations of different types or sizes. Regionally, some of the Eastern Mediterranean seaports can accommodate fourth and fifth generation ships with drafts of up to 16 meters (Piraeus).

The ability of these seaports to accommodate various sizes of motherships was once dependant on quay length, draft and the number of gantry cranes. During 1997, large operators in this region had a common complaint Seaport authorities were unable to guarantee more than 2 gantry cranes per mothership during operation. This is no longer the case in relation to Limassol, Port Said, Piraeus, Damietta and Haifa. The only seaports that are not equipped with gantry cranes are Lattakia and Beirut, which rely on floating cranes or the ship's own gear[23].

4.3.1 Piraeus: Greece

The seaport of Piraeus grew rapidly during the period 1997-2001. Taking into account the large domestic market, Piraeus may fulfill the criteria of many large operators and justifiably assume a hub role. New developments during 2003 include a 10-year contact agreement with MSC expected to accommodate motherships to the region of 7000 TEU, Ocean Shipping Consultants (2003) p 175. Currently, large shipping lines that serve Piraeus include Evergreen, MSC, Senator, NYK, Norasia, Lykes and MOL.

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[23] Personal consultation with GAP Vassilopoulos Ltd (2003).

However, even though there was an investment plan of 58 million USD, it does not account for two important deficiencies: the build-up of an inland rail infrastructure for the domestic market, (being the only European seaport that moves zero containers by rail) as well as investment in an EDI system. Another obstacle that Piraeus took time to overcome was the complicated system of tariffs, which raised complaints from all operators. Current feedback reveals that greater flexibility prevails as tariffs have been simplified.

For all characteristics and facilities, see Appendix VI.

4.3.2 Limassol: Cyprus

Limassol is the major seaport of Cyprus. Some of the advantages include the geographic location, with little deviation on the Suez-Gibraltar axis, offering good proximity to the neighbouring seaports of the East-Med. Even though the seaport has great potential, it is underutilized. Comparing the volumes of 1996, before current investments, the seaport handled 400,000 TEU. While during 2002 it only handled 250,000 TEU. One might expect that figures nowadays would have grown, especially after recent improvements of the seaport's infrastructure with the doubling of the loading and unloading capacity in order to service the fourth generation container ships. Instead, between 1995-2000 Limassol lost transhipment business, that no longer bring in motherships, e.g. COSCO, Evergreen, CMA, DSR, NYK, Contship, Norasia, Nedlloyd. The seaport is not involved in major transhipment operations and, as a result volumes dropped dramatically. Reasons may vary and possibly are not related to the characteristics or facilities of the seaport. One reason suggested is that neighbouring seaports are possibly more competitive. A further reason is that Cyprus

generates comparatively less local volumes. Moreover, there is the embargo imposed by Turkey on all vessels having a connection with Cyprus, e.g. Any Liner traffic using Cyprus as a transhipment hub. Cyprus seaport authorities claim that this embargo will no longer apply as from 1/5/2004, since Cyprus officially became a full member of the European Union.

However, in the last six years (1997-2003) the seaport has undergone major changes and improvements not only in terms of infrastructure equipment but also in relation to manpower, simplification and reduction of tariffs, flexible transhipment procedures and computerization. Some of the current lines operators include Sarlis, MSC, Borchard, ZIM, Nordana and AWS.

For all characteristics and facilities, see Appendix VII.

4.3.3 Damietta: Egypt

Damietta provides an excellent geographic location for transhipment offering almost zero deviation for the mothership, making the seaport very attractive in addition to the extensive hinterland that supports the large domestic market. During 2000, the seaport handled 560,000 TEU. When the author visited the seaport in 1997, it was handling only transit operations. Since then, important improvements have been made, especially with regard to handling equipment, as well as, the road network connecting Cairo, thus boosting local cargo. Furthermore, there are rail connections with other parts of the Nile Delta and Upper Egypt. Another prevalent characteristic is the low tariff (possibly the lowest in the Mediterranean); though it seems that Liner operators do not attach as much importance on this as they used to do. However, at some stage some large operators abandoned the seaport as a hub and shifted over to Gioia Tauro and Marsaxlokk.

CMA, MISC and NYK, are some of these lines. In an interview conducted by the author in 1997, the Director of Damietta Seaport, Mr. Wahed, was very optimistic about the future of this seaport. One of the prime advantages of Damietta is flexibility, as it is the only seaport in Egypt not under state control. As far as the selection of seaport labour is concerned, a more effective approach has been adopted. Seaport labour specifically excluded those working in existing national seaports, the reason being to avoid the introduction of historic working practices. In this respect, Damietta has become more price efficient and competitive. However, one of the issues that has not been effectively tackled is the (sometimes unpredictable) hourly stoppages on certain dates of the year due to strict Muslim ceremonies. These stoppages cause unpredictable delays during operations.

For all characteristics and facilities, see Appendix VIII.

4.3.4 Alexandria and El Dhekheila: Egypt

The seaport of Alexandria is the oldest in the Mediterranean and possibly the oldest in the world. It offers the advantage of geographic location, as well as, an extensive hinterland for local volumes. One of the prominent characteristics observed by the author in his visit is the lack of space in and around the seaport. This was further confirmed by Mr. Nasif, the manager of the seaport, in an interview conducted by the author. The seaport is constrained since it borders the city and suffers from storage problems because of congestion in the container yard. This affects the handling of the vessels on the berths. Furthermore, flexibility is lost since the seaport is completely under state control. Liner operators try to overcome this by using protecting agents, but they are still in need of greater effectiveness and control. The

author noticed during his visit that labour was not particularly skilful, damage could be inflicted on containers and there were unnecessary delays.

Alexandria Container Handling Co is the terminal operator at El Dhekheila container terminal, built in February 1997 and operating under state control. This seaport, situated just 10 kilometres west of Alexandria, was initially built to offer ample space to ease congestion and accommodate larger ships of maximum draft. At the beginning, the seaport handled 276,000 TEU and prospects seemed positive. However, many carriers have subsequently confirmed that prevalent winds and an imperfectly fitted break-water barrier produce rough seas within the seaport, making the entrance and operation difficult.

For all characteristics and facilities, see Appendix IX.

4.3.5 Port Said: Egypt

Port Said is on the main route of the Gibraltar axis offering zero deviation for the motherships. Similar to Alexandria, Port Said is bordering the city, thus one of the major problems is space constraint. However, many improvements have been made since 1997 by Port Said Container and Cargo Handling Company (PSCCHC). One of these is the addition of gantries, bringing the total number to 7. The potential for expansion of the seaport is heavily restricted by limited space, small water front and the passage of the entrance from Suez Canal directly through the seaport. A new seaport area is recently currently under construction at the East Port Said. This will include a 60 hectare transhipment terminal space and will be operated by Maersk Sealand and ETC with a 30% stake and a consortium of Egyptian companies, (Ocean Shipping Consultants (2003) p 202).

Furthermore, labour, similar to Damietta, is considered not particularly skilful, causing damages to containers as well as unnecessary delays. However, PSCCHC is investing towards upgrading the seaport in all sectors, including a recent installation of EDI. Possibly, one of the solutions is to work toward privatization. Some of the lines currently using the seaport are Contship, MOL, NYK, ZIM, Senator, K-line, and feeders of Evergreen.

For all characteristics and facilities, see Appendix X.

4.3.6 Haifa: Israel

Haifa is the largest of the Israeli seaports and has been the only Israeli seaport assuming a hub role. The domestic market is quite large, being a major reason to exploit further the hub role potential. However, weaknesses do exist such as the accessibility to major highways, railways and overall transport links. In a personal interview in 2004 with Mr. Mendi Zaltzman, it was stated that the Carmel Tunnel linking the South and Northern part of Haifa will greatly improve the transport links. It is expected to be completed during 2009-2010. Furthermore, the seaport experienced heavy congestion during 2002-2003. Many ships have had to wait outside the seaport and sometimes it took up to a week to berth and complete operations. Mr. M. Zaltzman pointed out that this congestion originated mainly due to multiple and frequent calls of ZIM lines motherships (vessels of 5000-6000 TEU), in addition to unforeseen seaport strikes.

Inevitably, such delays are a major drawback for operators and it also affects the economy of the country. Another issue that has held back the seaport from assuming a more competitive

hub status is the political situation and strong unionization. Unions in Israel are very powerful and any possible industrial dispute is a restrictive factor of hub potential. It is noted that the seaport is efficient with very skilful personnel, equipped with modern technology and EDI facilities.

Due to large local volumes, there are some large operators that call at Haifa, such as Maersk Sealand, MSC, and Yang Ming, whilst COSCO and ZIM are the only Liner operators that utilize the seaport as a transhipment hub in their westbound service from the Far East.

For all characteristics and facilities, see Appendix XI.

4.3.7 Ashdod: Israel

Ashdod is a smaller seaport than Haifa with low draft where large motherships of fourth generation cannot be accommodated. Furthermore, the seaport faces similar problems as Haifa such as congestion inflexibility in storage, strong unions, and inland network inefficiency.

For all characteristics and facilities, see Appendix XII.

4.3.8 Izmir Seaport: Turkey

Located on the western side of the Aegean Sea, Izmir is the third most populated city in Turkey. Overall, Turkish seaports can achieve more, since Turkey, being the biggest country of the Eastern Mediterranean, contains extensive hinterland and provides large volumes of cargoes. With a population of nearly seventy million and a vision to commence negotiations

for EU accession, the future of Turkish seaports can only improve through time. Evidently, significant growth is achieved during 2003 at Turkey's state-owned seaports as well as those in the private sector. However, despite the investments that are being made in Turkish seaports, to a large extent from the private sector e.g. Arkas in Ambarli seaport, there is clearly a need for further improvement to meet demand. Interestingly, until 2002 no Turkish seaport was able to accommodate Ships over 3,000TEU slot capacity, Ocean Shipping Consultants (2003).

Izmir excels as Turkey's main container seaport with considerable development since 1987 when it was handling 80,000 TEU whereas by 2004 it reached 650,000 TEU in 2003. Despite the continuous efforts by authorities to further boost potential, the seaport still lacks the competitive tools needed to play a hub role. Some of the Liner operators that call at Izmir include CMA, ZIM, Senator, Sarlis, LYKES, Norasia and Empross Tarros. The seaport works 24 hours daily.

For all characteristics and facilities, see Appendix XIII.

4.3.9 Mersin: Turkey

It is situated in the north-eastern part of the Eastern Mediterranean sea. The seaport's rail link and its convenient access through the transport network offer an advantage beyond the local market as a prosperous gateway to the Middle East. Amongst its advantages is the existence of a free-trade zone covering an area of 776,800m^2.

The prospects of this seaport in the future are possibly numerous in acting as a gateway provided there is political stability in the Middle East. Meanwhile, current facilities cannot accommodate any of the large ships due to draft limitations and lack of investment in infrastructure. Some of the current lines that use the seaport are ZIM, Blasco, POL, Sarlis, Senator, Nordona, Azov, Contship, CMA, BSC, Latvian and Messina.

For all characteristics and facilities, see Appendix XIV.

4.3.10 Beirut: Lebanon

Beirut, being the largest seaport in Lebanon, is perfectly located to serve the Arab interior as a transit hub. Unfortunately, the ongoing political instability in the Middle East has led to the imposition of trade barriers to the transit of goods towards the neighbouring countries. The removal of these barriers remains a major objective for Beirut authorities as soon as political stability prevails. Currently, the country lacks a sound transportation network causing significant inconvenience to the economy and an obstacle to the further growth of the seaport. The domestic market made tremendous progress, reaching approximately 250,000 TEU during 2000 and most likely this figure will grow further. However, the seaport is considered poor in terms of infrastructure with no ship shore gantries and currently one berth of 240m able to accommodate 13m draft ships. However, during 2001 a 2 berth container quay was completed though not equipped due to the withdrawal of the Dubai seaport authority investment plan signed in 1998. Equipment is due for delivery in 2004. In addition, a viable seaport requires support services from many ancillary services, such as, foreign banks and insurance companies. But, due to political instability, many have left Beirut. Some of the current lines using the seaport are CMA, SGM, Gracechurch, Sarlis, NYK, POL and Senator.

For all characteristics and facilities, see Appendix XV.

4.3.11 Lattakia: Syria

Lattakia seaport is considered Syria's main gateway seaport. There has been a rapid growth of container volume in the last 5 years. From 153,000 TEU is 1996, this figure increased to about 190,000 TEU in 2001. A further positive characteristic is the good network of links to both road and rail. This seaport can be regarded as an excellent gateway to the Arab interior. However, the seaport as well as the whole country, is lacking investment, which is affecting the whole economy. Moreover, the operational inflexibility is more than evident as it is a state-owned seaport with anachronistic policy and procedures. Although there are protective agents to safeguard the interest of ship-owners, still many complexities sometimes emerge causing long delays and even imposition of heavy penalties. This is considered a major drawback for any Liner operator since possible manifest corrections results in prolonged delays. In addition, the tariff system is complicated, there are no computer systems and, although volumes have increased, the progress is extremely slow and bureaucratic. Ship-to-shore gantry cranes have not yet been installed and the terminal equipment is regarded as old and ineffective. Some of the current Liner operators that call at Lattakia are Sarlis, Contship, Senator, Azov and MOL.

For all characteristics and facilities, see Appendix XVI.

4.4 Container Handling Tariffs

Regarding container handling tariffs, special discounts are very frequently negotiated amongst Liner operators and seaport authorities depending on volumes and commitments. Regarding the transhipment handling tariff, the lowest tariff is offered by the Egyptian seaport of Damietta: it ranges from 75-85 USD per container. During the author's visit in 1997, seaports that combined both transhipment and local trade, e.g. Limassol, Port Said, Alexandria, Piraeus and the two Israeli seaports, the transhipment tariff charged was higher and ranged between 150 USD and 200 USD for a double container move. Nowadays (2003), rates have been greatly reduced, flexibility prevails and industry conditions suggest that overall costs will be reduced further. As ships become bigger and volumes grow Liner operators exercise more leverage on seaport officials to deviate from their tariffs. At present, the Egyptian seaports offer the lowest transhipment tariff whilst Piraeus and Limassol offer a similar tariff of about 100 USD for a transhipment activity in and out, including cranage above certain TEU volumes[24]. The Israeli seaports' main problem is congestion rather than the tariff rate. Haifa may have similar tariffs with Limassol and Piraeus, when it comes to negotiate with large operators. For its part, until 2002, Syria is offering an old and anachronistic tariff based on weight and volumetric measure, ranging between 4-5 USD per ton. Turkish seaports are more expensive and so is Beirut in comparison to the Egyptian, Piraeus and Limassol seaports. Furthermore it is worth mentioning that full containers are charged approximately two-thirds more than empty containers. Again, Damietta Seaport is more price-competitive at around 30 USD per empty container and is followed by the other seaports in the range of 45 USD per container. This is considered a crucial cost factor in cases where many containers are repositioned empty due to lack of exports. The Gioia Tauro

[24] Personal interviews with Seaport Authorities

transhipment handling tariff varies in terms of the terminal and number of containers to be handled. It is in the range of less than 100 USD per container two-moves[25].

4.5 Eastern Mediterranean Seaports Seek a Hub Status

The geographic location and the proximity-distance factor is a key tool in investigating the possibility of an Eastern Mediterranean hub as a potential gateway (for cargoes originating from the Far East destined to the Eastern Mediterranean).

The strategic commercial location of hubs discussed by Fleming & Hayuth (1994) points to the fact that, through geographic location, seaports can generate cargo volumes by means of their centrality, intermediacy or a combination of these. More specifically

- Seaport centrality can generate cargoes through inland and neighbouring regions or as a destination, e.g. Rotterdam.
- Seaport intermediacy can generate cargoes en route minimizing deviation of the mothership acquiring transit cargoes, e.g. Algeciras.
- Seaports combining centrality and intermediacy, such as Hong Kong and Singapore, referred to as "Mega hubs", can generate large volumes of local cargo, since they are situated at the intersection of main trade routes; they can also act as transhipment centers.

Based on the centrality concept, it is obvious that seaports situated in the Eastern Mediterranean region, e.g. Damietta and Piraeus, offer closer proximity for their region in

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[25] Personal consultation with GAP Vassilopoulos Ltd.

comparison to centrally located seaport hubs, such as, Gioia Tauro and Marsaxlokk. In addition, they can both produce large local volumes, especially Egypt.

Furthermore, the intermediacy en route characteristic for central Mediterranean hubs is equally favourable when compared to some of the Eastern Mediterranean seaports, e.g., Damietta, which offers close to zero deviation for the mothership. In addition, a third characteristic, besides centrality and intermediacy, is put forward by the author, namely geographic proximity to-and-from.

4.6 A proposed hub choice criterion: The characteristic To-and-From

Since transit cargo is originating from the Far East, additional mileage is required for the mothership to cover half of the Mediterranean westbound from Suez (in case Gioia Tauro is the seaport hub). Thus, the distance from Suez to Gioia Tauro is 960 nautical miles, see Appendix XVII. From there onwards, the feeder ship from Gioia Tauro needs to cover additional mileage to service eastbound most of the Eastern Mediterranean seaports. Thus, the author proposes that proximity should not be evaluated only in terms of distance from the seaport hub towards the feedered seaports. To this effect, Sutcliffe (1995) p 96 has pointed out that the conditions for a successful transhipment seaport hub require the following: minimum deviation from the main shipping lanes of mother ships, the distance to the markets served (cost element of the feeder) and the tariffs charged in the seaport hub. However, the author suggests that, with the introduction of geographic proximity (to and from the seaport hub to the seaport of destination) e.g. through Suez to the seaport hub and to the Eastern

Mediterranean seaports, it is possible to better meet the criteria regarding transhipment success. Interestingly, the report by Zohil & Prijon (1999) identified significant correlation between seaport hub popularity generating large volumes of local cargo and smaller deviation of the mothership. The author points that this criterion may be used as an additional important tool towards investigating the reasons for seaport popularity. Thus, the author takes the view that local cargo volume is part of the ACTT (average cargo transit time) that affects the supply chain of the entire region. Consequently, a seaport hub that offers overall less transit time to the region served may claim further advantage. Zohil & Prijon (1999) have not questioned the reasons of local cargo importance. Furthermore, their forecast methodology totally neglected the forces of logistics supply chain.

Apart from the element of transit time comparison (analyzed in Chapter 7), other parameters should also be considered.

4.7 Implications of the recent experience in the Central-Eastern Mediterranean

Since 2001, Gioia Tauro faces periodic congestion (feeders)[26]. On many occasions, feeders had to wait for more than 4 days to berth. Sometimes, even reefer cargoes loaded on to feeders were not able to catch the mother vessels, and expensive perishable cargoes suffered heavy losses[27]. Furthermore, the seaport requires more investments for expansion. Feeder congestion and severe delays caused by a workforce is further validated by Ocean Shipping Consultants (2003) pp 173.

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[26] Personal consultation with Hapag-Lloyd.
[27] Personal consultation with Hapag-Lloyd.

Although motherships sustain efficient operations, which certainly please the Liner operators, transit cargoes, from there onwards, need to encounter similar scales of efficiency. Currently, this is not always the case. Moreover, due to unforeseen congestion, feeders become less reliable in their schedules and sometimes change rotation in order to avoid idle time while waiting to berth. Marsaxlokk only recently (2002) reestablished its credibility, following congestion problems, and only time will reveal the extent of its ability to generate full trust[28]. It is still questionable why the Grand and New world alliances shifted all operations from Marsaxlokk to Gioia Tauro in 2002, Ocean Shipping Consultants (2003) p 175. Apparently, no local volumes were recorded to induce the shift towards Gioia Tauro. Interestingly, Gioia Tauro does not generate local cargo volumes to the extent originally forecasted. On the contrary, local volumes are less than 5% of the total throughput; the remaining 95% is transhipment operations, Ocean Shipping Consultants (2003) p 173. Not surprisingly, recently the traffic experienced a shift of some Liner operators towards certain Eastern Mediterranean seaport hubs.

An example during 2002 is CMA, which introduced a further service to the Levant countries including Cyprus, via Damietta hub because it did not wish to depend entirely on Marsaxlokk or, possibly, with the purpose to offer less transit time from the Far East towards the Eastern Mediterranean countries[29]. Likewise, Hapag Lloyd decided to offer an additional gateway with less transit time via Damietta for the East-Med cargoes originating from the Far East. A further example is Yang Ming that shifted all its operations from Marsaxlokk in March 2003

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[28] Personal consultation with GAP Vassilopoulos Ltd.
[29] Personal consultation with Paccard and CMA (2003).

to Port Said for their service to the Eastern Mediterranean region from the Far East[30]. All above Liner operators namely CMA, Hapag Lloyd, Yang Ming, up until 2001 were serving the Eastern Mediterranean regions via centrally located hubs. The practical experience provides further justification to the objectives of this thesis, which includes assessment of the potential of Eastern-Mediterranean seaport to act as seaport hubs.

Furthermore, taking the view of shippers at both ends, this issue is even more critical in order to sustain viability of their ventures. The Far-East shippers, being in competition with other continental markets, i.e. Europe and USA, already face this major obstacle of longer transit times in serving the Eastern-Mediterranean countries. Evidently, the transit time of continental Europe towards the Eastern Mediterranean is, on average, 10 days[31]. Other schedules originating from Spain (Barcelona) or France (Marseilles) towards the Eastern Mediterranean require an average of 6 days transit time[32]. The long Far East transit times in comparison to European transit time constitute a major advantage for European shippers over the Far East shippers. The author suggests that the element of transit time is greatly in favour of the European shippers. Thus, there are doubts as to whether the existing volume figures represent the true traffic potential of this market (Far-East - Eastern Mediterranean).

A possible shortening of the transit time from the Far East could reveal true volume potentials, considering the fact that in certain trades transit time constitutes a major determining factor (McGinnis (1990); Brooks (2000) pp 64, 92).

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[30] Personal consultation with Yang Ming.
[31] Personal consultation with Maritime Bulgare.
[32] Personal consultation with Sarlis.

4.7.1 The Eastern Mediterranean market potential

The Eastern Mediterranean population now stands at approximately 145 million and is steadily increasing (not taking into account the Black Sea, which can be reliably served via an Eastern Mediterranean hub). In terms of cargo volumes (containers), although there are no relevant statistical data from governments, seaport authorities etc, a rough estimation for cargoes from and to the Far East - Eastern Mediterranean is approximately 1,500,000 TEU per annum[33].(2003)Furthermore according to Woodbridge (2004) traffic from Asia grew by around 25 per cent in 2003 where as volumes from Europe were up about 10 per cent. It appears that this growth of volumes originates from all regional countries of the Eastern Mediterranean and especially Egypt, Turkey, Greece. Turkey's economy is rapidly progressing reflecting also the container seaports volume during 2003. However, the estimated growth of the overall container throughput implies an increase of 63% between 1995-2001, including the Black Sea area (Ocean Shipping Consultants, 2003, p 175). Furthermore, according to Ocean Shipping Consultants (2003) pp 217 , projections between 2001-2010, the expected seaport container handling demand is to increase between 59-79% for the whole Eastern Mediterranean.

Currently, the Mediterranean market corresponds to more than 22 million TEU, Ocean Shipping Consultants (2003) pp 171-176. However, within the Eastern Mediterranean, total throughput is approximately 7 million TEU (2002). Interestingly, GDP growth during 2002 was 3.7% in Greece, 3.9% in Turkey, 2.5% in Cyprus, −1.5% in Israel, 2% in Egypt, Ocean Shipping Consultants (2003) pp 207. Indicatively, these figures represent growth potential. The need to handle motherships as well as more feeders effectively makes it necessary for a

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[33] Personal consultation with Sarlis.

number of seaports to act as hubs in different areas of the region. It appears that it is less likely for a small number of Mediterranean seaports to act as major hubs and serve efficiently beyond their regions.

4.7.2 Traffic increases from the Far East

Interestingly the world container seaport demand between the years 1995-2001 increased by 69% to 244 million TEU and by 9.2% during 2002 Ocean Shipping Consultants (2003) p 14. The most rapid growth is witnessed in the Asia market (East Asia) where, astonishingly, its total share of the world market increased from 37.6% in 1990 to 43.5% and close to 46.4% in 2002 Ocean Shipping Consultants (2003) p 14. Total container seaport demand in East Asia is forecast to grow by 85-103% over the 2001-2010 period to the levels of 205-226 million TEU, Ocean Shipping Consultants (2003) p 17. Most rapid expansion and growth, however, will centre on seaports in China. In the Chinese seaport region, a further growth of 88-99% is anticipated over 2001-2010, an increase of 84-89 million TEU Ocean Shipping Consultants (2003) p 17. During 1995-2001, the "Chinese seaport region", including Hong-Kong and Taiwan, doubled box volume to 44.9 million TEU, Ocean Shipping Consultants (2003) p 16. The author suggests that these developments in relation to expansion should not be neglected and most of the regions of the world, including the Eastern Mediterranean, may experience further traffic increases from the Far East.

4.7.3 Liner Operators benefit from more seaport hubs availability

The availability of a sufficient number of seaport hubs within the Mediterranean is an additional benefit to Liner operators. It is a common practice for Liner operators to utilise two hubs in the Mediterranean because of the vast market and long distances.

The choice of hubs creates competition amongst seaports and represents an intrinsic tool to further negotiate with seaport authorities. In addition, seaports become less congested and turnaround becomes faster.

Having reviewed the Eastern Mediterranean market it appears that 6 seaports namely Damietta, Alexandria, Port Said, Haifa, Limassol and Piraeus, are in competition with centrally located Mediterranean seaport hubs namely Gioia Tauro, Marsaxlokk and Taranto. These 6 seaports during 1996 generated approximately 100% of the total transshipment cargo volume.

In Chapter 5, the author will attempt to address a crucial aim of the study namely the selection of suitable seaport hubs that qualify as hubs amongst the selection of six aforementioned. For this the author conducted an investigation through a survey.

5. DETERMINING THE POTENTIAL EASTERN MEDITERRANEAN HUBS: A SURVEY

Here the author will attempt to demonstrate an important aim of the study namely, to determine the suitable seaport hubs in the Eastern Mediterranean amongst the six candidates. Given that Liner operators are the primary decision makers the author conducted an investigation through primary research. A questionnaire being forwarded to specific Liner operators namely Yang Ming, CMA, DSR Senator, Nedlloyd, Contship, Evergreen, and MISC. The author points that these shipping lines during the investigation carried approximately 85% of the cargo in the Eastern Mediterranean from the Far East. Other shipping lines, e.g. Maersk Sealand, MSC refused to respond to the questionnaire. The author acknowledges the confidentiality and commercial sensitivity that exist in the Liner industry.

Furthermore, the author visited all major candidate seaports through a field trip of 10 days in order to confirm some of the Liner operators' feedback. A number of 14 criteria were set within a range of 0-10 based on two parameters: first the rate of importance per criterion, and second, the score rated per specific criterion for each of the candidate seaports. It appears that through the average scoring methodology four seaports are considered to be more suitable.

This chapter offers an examination of the methodology adopted by the author in his attempt to address the main aim of the study, namely, the choice of a seaport hub in the Eastern Mediterranean among the available candidates. In what follows, the methodological issues pertinent to this aim are discussed.

5.1 Primary Research Design and Sampling

The author attempts to compare different seaports in terms of their ability to successfully meet the requirements of a successful seaport hub in the region. Given that shipping lines are the primary decision makers in the choice of a seaport, the author conducted a survey on the topic. The questionnaire in the survey was directed to specific Liner operators serving the region (from the Far East), i.e. the sample was not selected randomly.

Questionnaires were distributed to 9 major shipping lines operating also in Cyprus (namely, Yang Ming, CMA, DSR Senator, Nedlloyd, Contship, Evergreen, MISC)[34] in order to determine the criteria used by them in selecting a seaport in the Eastern Mediterranean and to assess their relative importance. However 2 Liner operators namely Maersk Sealand and

[34] Some of the named companies have changed status. e.g. Nedloyd is currently called P&O Nedloyd. CMA is CMA CGM, senator is acquired by Hanjin though it operates as a separate entity.

MSC did not respond. In the following section a copy of the questionnaire used in the study is provided.

The questionnaire was constructed on the basis of available data concerning the criteria considered important by shipping lines in choosing a hub. The questions were structured in such a way so as to allow information to be collected as input for the quantitative model to be used. Moreover, the author, as the representative of shipping lines, tested the questionnaire with professional experts. On certain occasions the author explained the interpretation of the criteria in the questionnaire.

5.2 The Questionnaire

The respondents of the questionnaire, see Appendix II, were Line Managers of Liner operators some of which obtained the questionnaire through their agents in Cyprus, and some others through the authors personal contacts.

In the questionnaire, respondents were first asked to indicate how important the criteria were to them. The list of criteria provided in the questionnaire was partly suggested in Bascombe (1995) p 95. Moreover, information from personal interviews with various shipping lines and seaport Authorities was also used. An additional criterion namely geographic proximity was added because the author takes the view that geographic location is considered as a separate criterion. Geographic location can be evaluated in terms of the deviation concept with reference to the mothership, whereas proximity of the market is the distance between a seaport and other regional seaports. Thus, Port Said might be the most advantageous seaport in terms of geographical location by offering no deviation for the mother vessel whereas

Table 5.1: Seaport Hub Criteria

1. Geographic Location
2. Proximity
3. Terminal Space
4. Land and Sea Access
5. Low Cost
6. Capable Labour
7. Transhipment Capability
8. Understanding Landlord
9. Handling of Equipment
10. Quick Turnaround
11. Feedering Connection
12. Labour Relations
13. Political Issues
14. Local Cargo Volume

Limassol may offer the closest distance on average from all other seaports in the region. The following is the full list of criteria provided to respondents:

It must be noted that, respondents were given the option of adding and evaluating more criteria if they considered them important. However, the list appears to have been exhaustive in that none of the 7 major lines indicated any additional criteria important to them.

In addition to rating the importance of the previously mentioned criteria on a scale of 1 to 10, respondents were asked to rate the level of satisfaction with a number of seaports on each criterion. The seaports rated were Limassol, Piraeus, Damietta, Port Said, Haifa and Alexandria, all considered to be potential seaport hubs. Again, a scale of 1 to 10 was used in all ratings.

5.3 Methods employed for the survey analysis

5.3.1 The Average Scoring Method

The author first considered the use of the average scoring method in order to analyze the existing data and arrive at comparisons among seaports. The method is similar to the Scoring Method (see Waters (1991) pp 133-176). For each questionnaire, the relative weights, i.e. the ratings of the companies as to the importance of the various criteria, are multiplied with the scores for the individual seaports. In order to combine the results of all companies, the corresponding cell values are added. This produces a table of total scores for each criterion. Then for each seaport, the total scores are added.

It is of more interest here to determine which seaports have more potential for the role of Eastern Mediterranean hubs. In this sense, a cut-off point is needed which can point out which seaports have this potential. For this reason, the author proposes an extension of the above method, namely the Average Scoring Method. This approach is based on finding the arithmetic mean (average) of the seaport's total scores, see equation (5.1).

$$\text{Average Total Score} = \frac{6851+7002+7435+6517+6849+6437}{6} = 6849 \qquad (5.1)$$

This value can now be used to determine which seaports fall above or below average total score.

The advantage of this method is that it is very easy to employ and it provides a clear-cut picture of the seaports with the greatest potential to act as hubs. However, by taking into account only the sum of total scores for each seaport, the importance of the scores of each

individual criterion for each seaport is eliminated. In this way, important information is lost. In addition, through this method, it is possible that extreme scores can give a misleading picture. For example, extremely low ratings on one criterion may bring the total score below average, while the scores for the remaining criteria are comparatively high.

In view of this, the author proposes a method that attempts to be more resistant to such extreme situations and, in addition, makes use of the same available information.

5.3.2 Gravity Scoring Method

This method is an extension of the average scoring method, Waters (1991). It considers the ratings for the importance of the criteria as weights in order to compute weighted averages of the various criteria scores for each seaport. In turn, the average of these "estimates" can be used as a cut-off condition for seaports qualifying for each criterion.

The first step is finding the weighted average amongst all companies, of the score of each criterion for each seaport using equation(5.2),

$$\text{Weighted Average Score}_{ij} = \frac{\sum_{k=1}^{l} c_{ijk} r_{ik}}{\sum_{k=1}^{l} r_{ik}},\ i = 1,2,\ldots,n(\text{criterion}); j = 1,2,\ldots,m(\text{port}) \quad (5.2)$$

where c_{ijk} corresponds to the i^{th} criterion score for the j^{th} seaport as given by the k^{th} individual company and r_{ik} to the rating of importance for the i^{th} criterion as given by the k^{th} individual company.

Table 5.2: Shipping Lines' Ratings of Geographic Location for the 6 seaports
(Quantities in brackets correspond to the rating of importance of Geographic Location)

		Yang Ming (8)	CMA (10)	DSR (10)	Nedlloyd (9)	Contship (10)	Evergreen (8)	MISC (10)
		k=1	2	3	4	5	6	7
Limassol	j=1	7	8	8	7	7	8	7
Piraeus	2	6	7	7	7	6	6	7
Damietta	3	8	10	10	10	10	9	9
Alexandria	4	7	9	9	9	8	9	9
Port Said	5	7	10	10	9	10	10	9
Haifa	6	7	8	8	7	5	5	7

This produces cell values which correspond to the weighted average of the scores of all companies, with ratings being used as weights. In order to define a cut-off point for these scores, the average score amongst all seaports for each criterion is calculated with the following equation

$$\text{Weighted Average Score}_j = \frac{\sum_{J=1}^{m}\sum_{k=1}^{1} c_{ijk} r_{ik}}{m\sum_{k=1}^{1} r_{ik}},\ i = 1,2,\ldots,n(\text{criterion}) \qquad (5.3)$$

In this manner, the criteria for each seaport qualifying for hub purposes can be determined. In what follows, the author provides an example of the application of the above method for one criterion. Criterion (i), chosen for this example, is geographic location. Table 5.2 provides the ratings of geographic location for various seaports as provided by the respondents companies.

As a first step, the weighted average score for each seaport is calculated using Equation (5.2). For instance, Limassol, corresponding to the j=1 seaport, scores as follows:

$$\begin{matrix}\text{Weighted}\\ \text{Average}\\ \text{Score}\\ (i=1, j=1)\end{matrix} = \frac{8\times7+10\times8+10\times8+9\times7+10\times7+8\times8+10\times7}{8+10+10+9+10+8+10} = \frac{483}{65} = 7.4 \qquad (5.4)$$

This is carried out for each seaport respectively, see Table 5.3. The average of the above weighted average scores can be estimated using Equation (5.3), as shown below

Table 5.3: Weighted Average Scores for Geographic Location

Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
7.4	6.6	**9.5**	**8.6**	**9.3**	6.8

$$\frac{7.4+6.6+9.5+8.6+9.3+6.8}{6}=8.0 \tag{5.5}$$

This quantity can now be used as a more refined basis for selecting the seaports that appear to be most suitable for the role of a hub in the Eastern Mediterranean. In the present example, and as seen in Table 5.3, Damietta, Alexandria and Port Said would be more suitable.

It is important to note that the above method was preferred over alternative methods because it was more appropriate for the project at hand. Other methods, combining importance ratings and ratings of criteria in order to compare objects or items, were rejected. For instance, a widely used model in Marketing is the Fishbein Model, Fishbein (1963), which is used to estimate consumer attitudes towards products/brands using consumer beliefs about the importance of objects and consumer ratings of the importance of these attributes. However, the Fishbein model was considered not appropriate for the present study because its use is more appropriate in consumer studies.

5.3.3 The Use of Confidence Intervals

The methodology discussed in this chapter and used in the study in order to rank a number of criteria makes use of *interval* estimation of averages, also known as *Confidence Intervals* (CI).

The reason for estimating a CI is that can obtain an interval, i.e., a range of values, where can fairly, say 90%, confident that the true (although unknown) average rating of one criterion lies. The expression for obtaining a 90% CI can be found in Sanders & Smidt (1991).

$$\overline{x} \pm t_{n-1,0.05} \times \frac{s}{\sqrt{n}} \tag{5.6}$$

where $\overline{x}$ is the estimated average, s is the estimated standard deviation, n is the number of observations in the data set (in our case $n = 7$) and $t_{n-1,0.05}$ is the, so called, t-value required to obtain a 90% CI for the average (in our case $t_{n-1,\,0.05}=t_{6,\,0.05}=1.943$). The latter can be obtained from statistical tables for the probabilities under the t-distribution.

One use of confidence intervals is to determine whether there are significant differences between the averages of the criteria, and, hence, between their hierarchical ranking. The decision rule for the comparison is carried out as follows:

If intervals of two criteria do not overlap, then there is a significant difference between their averages. Therefore, the ranking of the two criteria in terms of importance is evident; i.e., the criterion with the higher average rating seems to be more important than the one with the lower average.

In the following chapter, the methodological approach outlined in this chapter is applied to the data collected by the author in the effort to arrive at the seaports which are perceived to better meet the requirements of a seaport hub in the Eastern Mediterranean.

6. SURVEY FINDINGS

The findings of the survey reveal the strength and weakness of each seaport candidate as well as the top rated seaport hub. In summary, the most suitable potential seaport hubs are Damietta, Piraeus, Port Said, and Limassol. The results suggest that the most important criteria are local cargo volume and feedering connections, although others may overlap, which signifies that some are very similar in terms of importance. Local cargo is rated very high since the volume of containers is associated with lower costs for the Liner operator and because it decreases the average cargo transit time (see Chapter 7).

The findings indicate that the Liner operators who responded to the questionnaire can visualise a number of Eastern Mediterranean seaports with Potential to become a hub, and provide reliable hub services to the region.

6.1 The Choice of a Hub in the Eastern Mediterranean

The methodology outlined in Chapter 5 is employed in order to make comparisons among potential hubs and arrive at the seaport, or seaports, which seem to better fulfil the requirements of the role of the eastern Mediterranean hub.

Table 6.1: Questionnaire Ratings of Seaports by Yang Ming
Source: Survey questionnaire

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	8	7	6	8	7	7	7
Proximity	8	8	6	8	8	7	6
Terminal Space	7	8	6	9	5	5	7
Land and Sea Access	7	6	8	6	6	5	5
Low Cost	6	7	6	9	8	6	6
Capable Labour	7	7	8	6	5	6	7
Transhipment Capability	8	8	8	8	5	8	7
Understanding Landlord	7	9	8	9	5	6	7
Handling of Equipment	9	8	9	8	5	7	7
Quick Turnaround	9	9	8	10	6	6	9
Feedering Connection	10	9	9	10	10	9	7
Labour Relations	8	8	7	9	7	8	6
Political Issues	7	8	7	9	9	9	5
Local Cargo Volume	10	6	8	9	9	8	8

Table 6.2: Questionnaire Ratings of Seaports by DSR
Source: Survey questionnaire

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	8	7	10	9	10	8
Proximity	9	8	7	10	9	10	8
Terminal Space	10	7	8	8	5	6	7
Land and Sea Access	9	7	9	9	9	9	9
Low Cost	9	8	8	9	8	9	8
Capable Labour	9	9	9	7	7	7	9
Transhipment Capability	9	7	9	8	7	8	8
Understanding Landlord	7	10	10	9	7	7	10
Handling of Equipment	9	8	9	8	7	8	9
Quick Turnaround	10	9	9	9	6	8	8
Feedering Connection	10	8	10	10	7	8	7
Labour Relations	9	9	8	9	9	9	8
Political Issues	8	8	9	10	10	10	7
Local Cargo Volume	10	7	9	9	9	9	9

As mentioned in Chapter 5, shipping lines were asked to rate their level of satisfaction with 7 seaports on certain criteria using a scale of 1 to 10. Moreover, they were asked to indicate the importance of each criterion again using a 1 to 10 scale. Tables 6:1 to 6:7 which are constructed for each respondent operator, present the results of their evaluation of each seaport.

Table 6.3: Questionnaire Ratings of Seaports by Nedlloyd
Source: Survey questionnaire

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	9	7	7	10	9	9	7
Proximity	9	7	8	10	9	9	7
Terminal Space	10	8	7	9	6	6	7
Land and Sea Access	10	7	7	8	7	7	7
Low Cost	8	7	7	10	8	8	8
Capable Labour	8	9	8	8	8	8	9
Transhipment Capability	9	9	8	8	8	8	9
Understanding Landlord	8	9	8	9	8	8	8
Handling of Equipment	9	7	8	8	7	8	7
Quick Turnaround	9	8	8	8	7	7	8
Feedering Connection	10	8	8	7	7	8	7
Labour Relations	9	9	7	9	9	9	9
Political Issues	8	8	8	9	8	8	7
Local Cargo Volume	10	6	8	10	9	9	8

Table 6.4: Questionnaire Ratings of Seaports by Contship
Source: Survey questionnaire

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	7	6	10	8	10	5
Proximity	10	7	8	9	8	8	7
Terminal Space	9	10	8	8	8	7	7
Land and Sea Access	9	5	9	9	8	9	6
Low Cost	10	8	9	10	8	8	7
Capable Labour	10	10	8	9	9	9	9
Transhipment Capability	10	9	8	8	6	8	7
Understanding Landlord	8	8	8	9	8	9	7
Handling of Equipment	10	9	8	8	6	8	9
Quick Turnaround	10	9	8	9	8	9	8
Feedering Connection	10	8	9	10	7	10	5
Labour Relations	8	8	6	10	10	10	8
Political Issues	9	8	9	10	10	10	5
Local Cargo Volume	9	7	8	9	9	8	9

Table 6.5: Questionnaire Ratings of Seaports by Evergreen
Source: Survey questionnaire

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	8	8	6	9	9	10	5
Proximity	7	8	7	8	8	8	7
Terminal Space	10	7	9	9	7	7	7
Land and Sea Access	9	5	8	5	5	5	7
Low Cost	8	8	8	10	8	9	8
Capable Labour	9	10	10	9	9	9	8
Transhipment Capability	8	10	9	9	9	9	8
Understanding Landlord	8	9	8	7	7	7	9
Handling of Equipment	8	9	9	8	8	8	8
Quick Turnaround	10	9	9	8	6	6	8
Feedering Connection	9	8	10	9	8	8	6
Labour Relations	7	9	8	8	8	8	8
Political Issues	8	7	9	7	7	7	6
Local Cargo Volume	10	6	9	9	9	9	8

Table 6.6: Questionnaire Ratings of Seaports by MISC
Source: Survey questionnaire

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	7	7	9	9	9	7
Proximity	7	8	8	8	8	7	7
Terminal Space	10	9	10	8	7	8	8
Land and Sea Access	10	7	8	6	6	5	7
Low Cost	8	7	7	9	7	9	7
Capable Labour	9	10	10	8	8	8	8
Transhipment Capability	9	8	9	9	9	8	8
Understanding Landlord	9	9	8	8	8	8	9
Handling of Equipment	8	8	9	8	8	8	8
Quick Turnaround	10	9	9	8	7	6	7
Feedering Connection	9	8	10	9	8	8	7
Labour Relations	7	9	8	8	8	7	9
Political Issues	8	8	8	7	7	7	6
Local Cargo Volume	10	6	9	9	9	9	9

6.2 Seaport Criteria Importance

Shipping lines used ten points (10) as the highest possible rating a certain criterion can have in terms of its importance and assigned rates on the basis of an examination of the regional area of the Eastern Mediterranean. In what follows, the average rating of importance assigned to each criterion by the 7 shipping lines, Table 6.7, is discussed. The criteria are ranked

Table 6.7: Average Scores of Criteria Importance
Source: Calculated by author

	Rating Criterion	Score
1.	Local Cargo Volume	9.71
2.	Feedering Connection	9.71
3.	Quick Turnaround	9.57
4.	Geographic Location	9.29
5.	Terminal Space	9.29
6.	Land and Sea Access	8.86
7.	Handling of Equipment	8.86
8.	Capable Labour	8.71
9.	Transhipment Capability	8.57
10	Proximity	8.43
11	Low Cost	8.43
12	Labour Relations	8.00
13	Political Issues	8.00
14	Understanding Landlord	7.86

according to the ratings they received from the shipping lines starting from the one which received the highest.

The method described in section 5.3.3 was used in order to determine the confidence intervals for the average ratings of the criteria, as these were given in Table 6.7. An example of how this was done is given for one criterion, namely, that of low cost.

In order to estimate a 90% Confidence Interval for the average rating of Low Cost, can begin by considering the ratings of the 7 companies questioned which rated this criterion as follows:

6 10 9 8 10 8 8

The estimated average ($\bar{x}$) and standard deviation (s) are found to be 8.43 and 1.40 respectively. Substituting these in Equation (5.6), the following is obtained

$$8.43 \pm 1.943 \times \frac{1.40}{\sqrt{7}} \tag{6.1}$$

Table 6.8: Confidence Intervals for the Average Ratings of Criteria
Source: Calculated by author

	Criteria	Estimated Average	Estimated St. Dev.	Lower Bound	Upper Bound
1.	Local Cargo Volume	9.71	0.49	9.36	10.00
2.	Feedering Connection	9.71	0.49	9.36	10.00
3.	Quick Turnaround	9.57	0.53	9.18	9.96
4.	Geographic Location	9.29	0.95	8.59	9.98
5.	Terminal Space	9.29	1.11	8.47	10.00
6.	Land and Sea Access	8.86	1.07	8.07	9.64
7.	Handling of Equipment	8.86	0.69	8.35	9.36
8.	Capable Labour	8.71	0.95	8.02	9.41
9.	Transhipment Capability	8.57	0.98	7.85	9.29
10.	Proximity	8.43	1.13	7.60	9.26
11.	Low Cost	8.43	1.40	7.40	9.45
12.	Labour Relations	8.00	0.82	7.40	8.60
13.	Political Issues	8.00	0.58	7.58	8.42
14.	Understanding Landlord	7.86	0.69	7.35	8.36

This result tells us that can be 90% confident that the average rating for Low Cost lies somewhere between 7.40 (lower bound) and 9.45 (upper bound). The Lower and Upper bounds for the 90% C.I. for the averages of all criteria ratings are shown in Table 6.8. Criteria are sorted according to the estimated average. Note that the 90% level of confidence was used in order to avoid intervals with upper bound exceeding the value of 10 (maximum rating). A graphical depiction of the results is given in Figure 6:1.

Figure 6:1: Graphic Depiction of CI Estimation for Ranking Criteria

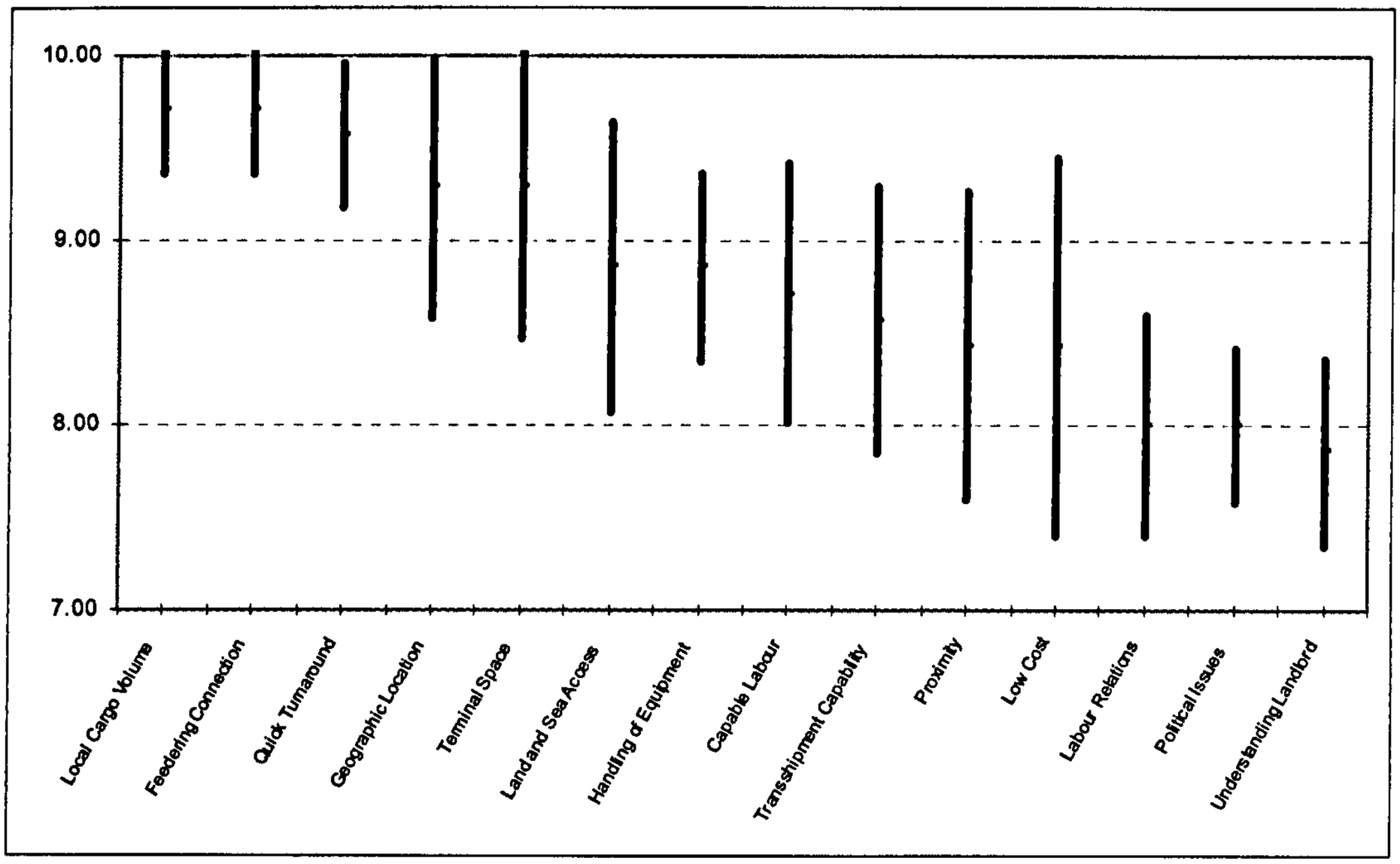

Table 6.9: Significant Differences between Rating Criteria

Feedering Connection & Local Cargo Volume	with	Transhipment Capability Proximity Labour Relations Political Issues Understanding Landlord
Quick Turnround	with	Labour Relations Political Issues
Geographic Location & Terminal Space	with	Political Issues

The graph above can be used to easily identify the ratings of criteria that are significantly different. Table 6.9 gives a summary of criteria that are found to have significant differences in their average ratings. Any other pairs of ratings do not show significant differences. This suggests that for such pairs, no comparisons may be made as to their ranking of importance.

The above table suggests that feedering connection and local cargo are especially important criteria in the choice of a seaport hub. This is because its high average rating (9.71) is significantly different from that of several other criteria. Quick Turnround, geographic location and terminal space are also very important and are significantly different from a lower number of criteria. Table 6.9 suggests that for the criteria ranked five to fourteen in Table 6.7, their ranking is not based on statistically significant differences.

Can now turn to a discussion of all fourteen criteria included in the questionnaire, in the order in which they were ranked in Table 6.7.

Local cargo volumes

Liner operators, in general, consider this criterion as very important and it is not a coincidence that many seaports generating substantial volumes of local cargo, e.g. Rotterdam, Hong Kong, Pusan, Kaohsiung and Singapore were chosen as seaport hubs for transhipment. This is correlated with the notion that Liner operators provide better service towards a large market (direct service less transit time) and, at the same time, enormous savings could be expected from stevedoring, where otherwise the specific seaport was to be served through transhipment via another seaport hub, hence involving double handling.

Feedering Connections

A feedership complements the mothership and provides an extension of the service offered by Liner operators. The more regular the feedering service, the better it is for the reliability of service. Where no regular feeders exist, the whole service collapses, including the line haul. A regular feeder schedule is usually expected to run every two to three days. Given the

importance of feedering connections, it is not surprising that shipping lines considered this to be the most important criterion and assigned it an overall rating of 9.71.

Quick Turnaround

Quick turnaround is an important consideration for shipping lines. Motherships are extremely expensive to buy and operate. The purpose for which they are built is to achieve more economies of scale in terms of volume and cover more voyages per year. Hence, even minimal delays in terms of hours can be crucial in the overall strategy of Liner operators. Possible regular delays in the operation might make it necessary to acquire additional ships to compensate for the schedule difference, or to cover less voyages per year. Furthermore, delays of even a few hours might have an escalating factor, thus affecting the next seaport of call where additional delays might arise because of, for example, missing the convoy on a specific time.

Geographic Location

As expected, geographic location was also very important to shipping lines. Geographic location should offer minimum deviation for the mothership and is considered vital for all Liner operators since it can result in large cost savings. The time saved from no deviation might offer the opportunity for complementing another voyage or even saving the cost of an additional mothership entering the service.

Terminal Space

This criterion received the same rating as geographic location and can also be considered as extremely important. Shipping lines require sufficient space within the seaport hub where they can position large volumes of containers. Furthermore, this enhances better operation

and security. Certain seaport hubs offer an even bigger advantage to shipping lines by providing large areas of space very near the terminal for their exclusive use thus helping their operation. Moreover, quay terminal space needs to be large enough to accommodate simultaneously more than three motherships. This depends on the berthing availability on arrival of the vessel.

Land and Sea Access

Land and sea access was also very important for respondents even though its average score was below 9. Shipping lines generally favour seaports that can generate cargoes both in terms of sea and land through borders with other countries. Continental seaports such as Antwerp and Rotterdam provide such benefits as they are both utilised for domestic cargoes through sea and, at the same time, act as land passage towards Central Europe. Carriers seek such opportunities since they can serve more markets through fewer calls, and minimise extra stevedoring cost through feedership

.Handling Equipment

Handling equipment was as important to respondents as land and sea access. Seaport hubs are expected to differ from ordinary seaports in their ability to offer better service in terms of efficiency and overall quality. Handling equipment should be satisfactory in terms of numbers as well as in variety and quality. Motherships require enough gantries during operation, which must be available immediately upon arrival. Seaports that do not have the adequate number of gantries may lose important potential customers since this is directly related to the quick turnaround of the vessel. The greater the number and better quality of equipment a seaport hub has, the better it is for operators.

Capable Labour

This criterion received a comparatively high rating reflecting the importance shipping lines attach to the availability of capable labour at a seaport hub. Capable labour provides not only for efficiency but also for reliability of the operation. With the latest technological advances, skilful personnel are needed at all levels within the seaport. Furthermore, Liner operators highly appreciate labour skills with special emphasis on the care that is given to their equipment. The efficient handling of containers is translated into enormous savings during operations.

Transhipment Capability

The tracking record of a seaport and its current state of operation provide an overall image as to the ability to act as a hub. Seaports with years of experience in transhipment operations, especially with large operators, are good candidates for the hub role. Furthermore, seaports handling large carriers or maintaining Liner operators for a long period of time are in a better position to cope.

Geographic Proximity

Geographic proximity is considered important by shipping lines in that a particular seaport hub should have close proximity in relation to other regional seaports. The nearer other seaports are, the better it is in terms of transit time, service reliability and overall feedering costs.

Low Costs (Handling)

Low cost was somewhat less important than expected. This is indicative of the fact that shipping lines are not willing to accept poor service for low cost.

However, cost remains an important factor in the choice of a seaport hub. Since stevedoring is a two-way move, costing can be crucial considering the large volumes a Liner operator may have. Practice has shown that the most popular and busiest seaports are the ones offering substantially low tariffs, e.g. Hong Kong, Singapore, Damietta seaports.

Labour Relations

This is an important factor to shipping lines even though its comparatively lower rating may suggest that shipping lines take it for granted that they will not face problems in this area. A seaport hub needs to convey trust and avoid any industrial disputes. A good climate of industrial and labour relations is considered positive as it affects the overall reliability of the seaport. Genoa and Fos seaport hubs are classic examples of bad management where industrial disputes forced large operators to seek alternatives causing huge losses, Hunter (1996). In an industrial dispute, possible time stoppages during operations affect the overall service.

Political Issues

Certain seaports were greatly affected in the past and still are either positively or negatively by political issues, e.g. Israel and Cyprus. Consequently, certain carriers may choose not to utilize a specific seaport as a hub or even service a seaport.

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An Understanding Landlord

Even though this criterion received a comparatively low rating, it is important to keep in mind that the lack of an understanding landlord can create serious problems for a seaport. Shipping lines can make or break a seaport. Seaports are very vulnerable since they much depend on the decision of shipping lines. That is why, nowadays, seaports need to be

Table 6.10: Total Weighted Ratings of Seaports by Yang Ming
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	8	56	48	64	56	56	56
Proximity	8	64	48	64	64	56	48
Terminal Space	7	56	42	63	35	35	49
Land and Sea Access	7	42	56	42	42	35	35
Low Cost	6	42	36	54	48	36	36
Capable Labour	7	49	56	42	35	42	49
Transhipment Capability	8	64	64	64	40	64	56
Understanding Landlord	7	63	56	63	35	42	49
Handling of Equipment	9	72	81	72	45	63	63
Quick Turnaround	9	81	72	90	54	54	81
Feedering Connection	10	90	90	100	100	90	70
Labour Relations	8	64	56	72	56	64	48
Political Issues	7	56	49	63	63	63	35
Local Cargo Volume	10	60	80	90	90	80	80

understanding and flexible in meeting the needs of carriers and overall supply chain collaborators. A seaport that does not provide flexibility and eagerness to be collaborative is destined to fail.

6.3 Ratings of Criteria Used as Weights

The ratings of seaports and criteria provided by shipping lines and presented in Table 6.1-Table 6.6 allowed for the calculation of total weighted ratings of seaports by each shipping line. These are given below. The weighted total ratings of seaports for each criterion are given in Table 6.10-Table 6.16. Based on these ratings, weighted average ratings of seaports on each criterion were estimated.

Table 6.11: Total Weighted Ratings of Seaports by CMA
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	80	70	100	90	100	80
Proximity	9	90	45	72	63	72	72
Terminal Space	9	54	72	81	45	45	63
Land and Sea Access	8	40	64	48	40	48	48
Low Cost	10	70	80	90	80	70	60
Capable Labour	9	63	63	45	36	45	72
Transhipment Capability	9	72	72	63	54	72	72
Understanding Landlord	8	64	56	72	40	56	56
Handling of Equipment	9	72	81	72	36	72	72
Quick Turnaround	9	81	72	81	45	72	72
Feedering Connection	10	90	100	100	90	80	50
Labour Relations	8	64	56	72	64	72	64
Political Issues	8	64	56	72	72	72	56
Local Cargo Volume	9	63	72	81	81	72	72

Table 6.12: Total Weighted Ratings of Seaports by DSR
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	80	70	100	90	100	80
Proximity	9	72	63	90	81	90	72
Terminal Space	10	70	80	80	50	60	70
Land and Sea Access	9	63	81	81	81	81	81
Low Cost	9	72	72	81	72	81	72
Capable Labour	9	81	81	63	63	63	81
Transhipment Capability	9	63	81	72	63	72	72
Understanding Landlord	7	70	70	63	49	49	70
Handling of Equipment	9	72	81	72	63	72	81
Quick Turnaround	10	90	90	90	60	80	80
Feedering Connection	10	80	100	100	70	80	70
Labour Relations	9	81	72	81	81	81	72
Political Issues	8	64	72	80	80	80	56
Local Cargo Volume	10	70	90	90	90	90	90

Table 6.13: Total Weighted Ratings of Seaports by Nedlloyd
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	9	63	63	90	81	81	63
Proximity	9	63	72	90	81	81	63
Terminal Space	10	80	70	90	60	60	70
Land and Sea Access	10	70	70	80	70	70	70
Low Cost	8	56	56	80	64	64	64
Capable Labour	8	72	64	64	64	64	72
Transhipment Capability	9	81	72	72	72	72	81
Understanding Landlord	8	72	64	72	64	64	64
Handling of Equipment	9	63	72	72	63	72	63
Quick Turnaround	9	72	72	72	63	63	72
Feedering Connection	10	80	80	70	70	80	70
Labour Relations	9	81	63	81	81	81	81
Political Issues	8	64	64	72	64	64	56
Local Cargo Volume	10	60	80	100	90	90	80

Table 6.14: Total Weighted Ratings of Seaports by Contship
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	70	60	100	80	100	50
Proximity	10	70	80	90	80	80	70
Terminal Space	9	90	72	72	72	63	63
Land and Sea Access	9	45	81	81	72	81	54
Low Cost	10	80	90	100	80	80	70
Capable Labour	10	100	80	90	90	90	90
Transhipment Capability	10	90	80	80	60	80	70
Understanding Landlord	8	64	64	72	64	72	56
Handling of Equipment	10	90	80	80	60	80	90
Quick Turnaround	10	90	80	90	80	90	80
Feedering Connection	10	80	90	100	70	100	50
Labour Relations	8	64	48	80	80	80	64
Political Issues	9	72	81	90	90	90	45
Local Cargo Volume	9	63	72	81	81	72	81

Table 6.15: Total Weighted Ratings of Seaports by Evergreen
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	8	64	48	72	72	80	40
Proximity	7	56	49	56	56	56	49
Terminal Space	10	70	90	90	70	70	70
Land and Sea Access	9	45	72	45	45	45	63
Low Cost	8	64	64	80	64	72	64
Capable Labour	9	90	90	81	81	81	72
Transhipment Capability	8	80	72	72	72	72	64
Understanding Landlord	8	72	64	56	56	56	72
Handling of Equipment	8	72	72	64	64	64	64
Quick Turnaround	10	90	90	80	60	60	80
Feedering Connection	9	72	90	81	72	72	54
Labour Relations	7	63	56	56	56	56	56
Political Issues	8	56	72	56	56	56	48
Local Cargo Volume	10	60	90	90	90	90	80

Table 6.16: Total Weighted Ratings of Seaports by MISC
Source: Calculated by author

	Rating	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
Geographic Location	10	70	70	90	90	90	70
Proximity	7	56	56	56	56	49	49
Terminal Space	10	90	100	80	70	80	80
Land and Sea Access	10	70	80	60	60	50	70
Low Cost	8	56	56	72	56	72	56
Capable Labour	9	90	90	72	72	72	72
Transhipment Capability	9	72	81	81	81	72	72
Understanding Landlord	9	81	72	72	72	72	81
Handling of Equipment	8	64	72	64	64	64	64
Quick Turnaround	10	90	90	80	70	60	70
Feedering Connection	9	72	90	81	72	72	63
Labour Relations	7	63	56	56	56	49	63
Political Issues	8	64	64	56	56	56	48
Local Cargo Volume	10	60	90	90	90	90	90

Table 6.17: Weighted Total Ratings of Seaports
Values are obtained by adding the corresponding cell values of Table 6.10-Table 6.16
Source: Calculated by author

	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa	Average
Geographic Location	483	429	616	559	607	439	522
Proximity	471	413	518	481	484	423	465
Terminal Space	510	526	556	402	413	465	479
Land and Sea Access	375	504	437	410	410	421	426
Low Cost	440	454	557	464	475	422	469
Capable Labour	545	524	457	441	457	508	489
Transhipment Capability	522	522	504	442	504	487	497
Understanding Landlord	486	446	470	380	411	448	440
Handling of Equipment	505	539	496	395	487	497	487
Quick Turnaround	594	566	583	432	479	535	532
Feedering Connection	564	640	632	544	574	427	564
Labour Relations	480	407	498	474	483	448	465
Political Issues	440	458	489	481	481	344	449
Local Cargo Volume	436	574	622	612	584	573	567
TOTAL	**6851**	**7002**	**7435**	6517	**6849**	6437	6849

Table 6.18: Weighted Average Ratings of Seaports on each Criterion
(Gravity Scoring Method)
Source: Calculated by author

	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa	Average
Geographic Location	7.4	6.6	**9.5**	**8.6**	**9.3**	6.8	8.0
Proximity	**8.0**	7.0	**8.8**	**8.2**	**8.2**	7.2	7.9
Terminal Space	**7.8**	**8.1**	**8.6**	6.2	6.4	7.2	7.4
Land and Sea Access	6.0	**8.1**	**7.0**	6.6	6.6	6.8	6.9
Low Cost	7.5	7.7	**9.4**	7.9	**8.1**	7.2	7.9
Capable Labour	**8.9**	**8.6**	7.5	7.2	7.5	**8.3**	8.0
Transhipment Capability	**8.4**	**8.4**	**8.1**	7.1	**8.1**	7.9	8.0
Understanding Landlord	**8.8**	**8.1**	**8.5**	6.9	7.5	**8.1**	8.0
Handling of Equipment	**8.1**	**8.7**	**8.0**	6.4	**7.9**	**8.0**	7.8
Quick Turnaround	**8.9**	**8.4**	**8.7**	6.4	7.1	**8.0**	7.9
Feedering Connection	**8.3**	**9.4**	**9.3**	8.0	**8.4**	6.3	8.3
Labour Relations	**8.6**	7.3	**8.9**	**8.5**	**8.6**	8.0	8.3
Political Issues	7.9	**8.2**	**8.7**	**8.6**	**8.6**	6.1	8.0
Local Cargo Volume	6.4	**8.4**	**9.1**	**9.0**	**8.6**	**8.4**	8.3

In what follows, each of the main seaports in the Eastern Mediterranean is examined separately based on the average score ratings assigned to it on each criterion by shipping lines. The survey performance of each seaport is discussed in the following section as shown by the ratings provided in Table 6.18.

6.4 Survey Performance of Seaport hubs and Recommendations

Recommendations are based on the data obtained from the survey, and from the author's knowledge obtained during a field trip to most of these seaports during 1997.

6.4.1 Damietta seaport

The seaport of Damietta received above average scores in all but one criterion and in this respect, it can be considered to have an advantage over Limassol and Piraeus with respect to fulfilling the requirements of the hub role. The only criterion in which it scored below average was capable labour. The low rating for labour can be explained by the fact that labour at the seaport of Damietta is not particularly skilful. Damietta has a high proportion of containers damaged in handling.

The seaport of Damietta received very high ratings in the areas of quick turnaround, local cargo volume, geographic location, terminal space, low cost and feedering connections. Damietta offers a major advantage in terms of location providing almost zero deviation for the line haul. Moreover, there is ample terminal space and the quay terminal can accommodate more than three motherships at a time which is considered more than adequate. Furthermore, shipping lines may have their own space within the terminal.

As reflected in the rating, the seaport of Damietta offers by far the lowest tariff. This is the case not only within the Eastern Mediterranean but possibly in comparison to the whole of the Mediterranean. Special discounts are granted in transhipment stevedoring and the tariff depends on the volumes generated by the Liner operator.

The high rating in feedering connections is due to the fact that regular feeder sailings exist every three days towards major regional seaports of the Eastern Mediterranean. As regards the remaining criteria, geographic proximity to the neighbouring seaports is good. Moreover, in 2002, Egypt generated more cargo volumes than any other country in the region. Inland transport is acceptable and is improving for the domestic cargoes. There are no shipments carried inland towards other countries, which could be beneficial. Furthermore, it is well recognised that Damietta has very understanding management. It provides flexibility and eagerness to take into account the needs of Liner operators.

Damietta also has an acceptable number of gantry cranes and may guarantee minimum two per mothership simultaneously during operation. It is thus not surprising that its rating in the criterion of handling equipment is slightly above average even though more gantries are needed for this purpose so as to provide more efficient service. Other handling equipment is regarded up-to-date and adequate in numbers.

With regard to transhipment capability, both track history and the current situation are very good indicating a likely future prosperity. Damietta has specialised in transhipment activities since the day of its establishment being the only non state seaport in Egypt. However, it is lacking in sophisticated computerised systems as well as in ideal telecommunication systems.

Finally, no major industrial disputes or political issues have affected the performance of the seaport in recent years, which is reflected in the ratings provided by respondents.

Despite its overall high rating, the seaport of Damietta requires significant improvements in the area of labour. Better skill is needed on behalf of labour to eliminate damages on the equipment as well as to improve productivity levels for faster turnaround of Mother ships.

Other areas for improvement include EDI technology and handling of equipment (type, quality and quantity).

6.4.2 Piraeus seaport

Piraeus' ratings is considered to be good as it received high ratings on all criteria except for geographic location, proximity, low cost and labour relations. Piraeus' geographic location is the most disadvantageous of all regional seaport hubs of the Eastern Mediterranean in terms of serving this market. However, extra mileage for the line-haul is not regarded as unacceptable.

With regard to cost, Piraeus was rated below average. However, since 2001 many discounts were granted to major Liner operators through official tariffs, and this continued during 2003 towards MSC Lines. The seaport tariffs cannot be compared to those of the Egyptian seaports but are steadily improving.

Once, labour relations, constituted a major problem for Piraeus as it suffered from industrial labour disputes causing delays to operations. The current situation is better in this respect even though not ideal.

The seaport of Piraeus received very high ratings in the areas of terminal space, local cargo volumes, land and sea access, and feedering connections. As regards terminal space, there is

ample space in the container yard as well as in the quay and terminal for simultaneously accommodating more than 3 mother ships. However since 2003 the seaport suffers periodic congestions due to large volume business originating from MSC Lines.

An added advantage of Piraeus is the fact that Greece borders the Balkans, even though cargo volumes have not increased dramatically via Piraeus. A possible reason may be the fact that Inland transport infrastructure is considered relatively poor. Moreover, regular and reliable feeders exist towards all the major regional seaports.

The performance of the seaport of Piraeus in terms of quick turnaround is considered very good, with both skilful labour and adequate number of gantry cranes. The Piraeus seaport has made tremendous progress in the area of being an understanding landlord. Not only have they become good and understanding listeners but they have also implemented an aggressive marketing policy to attract more shipping lines.

The Piraeus seaport has the best quality and most adequate number of handling equipment of all seaports in the Eastern Mediterranean. Especially regarding gantry cranes, Piraeus operates ten and expects more to be installed.

Consequently, and as shown by its ratings, the seaport of Piraeus has all the credentials and track history to be regarded as a capable hub. Transhipment is a major activity of the seaport servicing many reputable Liner operators (57% of seaports activities during 2003). Furthermore, the latest technological advances in EDI technology have provided added value even though the telecommunication system is far from ideal.

Overall Piraeus requires improvements in the area of low cost, labour relations, better technology and an investment in the inland infrastructure. Most importantly, according to the Chief Executive Officer Mr Theophanis, it is required to activate an immediate expansion plan to avoid current periodic congestion problems (2003-2004). The PPA is undertaking a major infrastructure development plan which involves the extension and further upgrading of the Eleftherios Venizelos container terminal expected to be implemented around 2006.

6.4.3 Limassol seaport

The seaport of Limassol received higher than average ratings on all criteria except for geographic location, land and sea access, low cost, political issues, and local cargo volumes.

As far as location is concerned, Limassol's geographic location is less advantageous than that of the Egyptian seaports with possible deviation for the mothership reaching approximately 12 hours. Moreover, Limassol, being a small island seaport does not generate large volumes of cargo and is the only seaport lacking in the area of land and sea access among the Eastern Mediterranean seaports. However these are not considered to be controllable factors for improvement. Another issue that falls in same category is the political factor. Political issues may be considered an important negative factor in the case of the seaport of Limassol. Due to the Turkish occupation since 1974, there is an embargo on behalf of Turkey on Greek Cypriot seaports acting as hubs for their cargoes. Thus, there is a possibility that certain operators may be reluctant to utilise the seaports of Cyprus for this reason.

It also appears that Limassol is less price competitive than most other Mediterranean seaport hubs. It must be noted that the official tariff has been greatly reduced even though it is still not comparable to the Egyptian seaports tariff.

Labour relations are good even though they need further improvement in the collaboration between the various users. On extremely rare occasions, hourly stoppages may take place.

The seaport of Limassol is particularly strong in the areas of capable labour, understanding landlord, equipment handling, transhipment capability and feedering connection where its scores are considerably above average. Especially with regard to transhipment, it must be noted that both past experience and the current situation are very good. Limassol has the capability, in all respects, to act as a transhipment hub. Among other advantages, Limassol provides an added benefit in terms of its well-developed telecommunication system which acts as a main switchboard of the regional area. Moreover, regular feedering services exist towards all regional areas.

The performance on turnaround is rated as good with skilful labour, an acceptable number of gantries (compared to the amount of business currently generated), as well as, good coordination. Its geographic proximity is also advantageous compared to some other neighbouring seaports.

A major controllable improvement area for Limassol appears to be that of cost, as its prices are somewhat higher than those of its main competitors. An improvement towards better collaboration, develop more terminal space as well as more enlargement of quays is recommended. Furthermore it requires more and latest technology of gantry cranes in order to attract the large Liner operators.

6.4.4 Port Said seaport

Port Said qualifies overall as a hub in that it received above average ratings in nine criteria. These were local cargo volumes, geographic location, proximity, low cost, handling equipment, labour relations, political issues, feedering connection, and transhipment capability.

Port Said's geographic location is very advantageous as it provides absolutely zero deviation for the line-haul. Its geographic proximity to the neighbouring seaports is also perceived as good. Moreover, the seaport tariff is acceptable though not as low as Damietta. Overall, it is considered more expensive than Damietta, but less expensive than Greece and Cyprus. With respect to labour relations and political issues, the ratings are above average.

As far as the ratings below average are concerned, terminal space is considered a major disadvantage in that space is restricted in the terminal and the seaport seems congested. No room for further expansion exists since the seaport is bordering the city. This is reflected in the low rating.

Port Said provides for both sea and land access, even though it was rated below average. Inland transport is acceptable for their local cargoes. No cargoes are carried towards their bordering countries, which may be the reason for the lower than average rating. Feedering towards the regional seaports from Port Said was rated above average even though in practice it does not take place on a regular basis. In addition, labour within the seaport of Port Said is not particularly skilful. Damages on equipment once used to be a regular phenomenon. However, good productivity has been recorded. Better skill as well as better equipment is

needed. Furthermore, during Muslim ceremonies, stoppages are recorded causing delays. Under the new management, Port Said made improvements in this area. Today the policy of the seaport is to be closer to the problems of Liner operators offering greater flexibility. However, the rating suggests that Port Said needs further improvement.

The performance of Port Said requires improvements also in a number of areas and especially in the availability of terminal space, the performance of its labour force, and the speed of turnaround. Furthermore, it can be argued that major improvements in terminal space require a lot of finance since the seaport is bordering the city. Given its limited potential in achieving progress in this area, Port Said should be improved in terms of its cost, labour, turnaround, responsiveness to its customers, handling equipment and EDI technology.

The new plans of Maersk Sealand (30% participation) to establish a new modern hub terminal 3 km from Port Said (to be completed by end 2004) is expected to play a major role in the regional area. Suez Canal Container Terminal (SCCT) is a private joint venture company which obtained the concession to operate, built, manage the new terminal. The majority shares (60%) is held jointly by ECT of Rotterdam and APM terminals of Copenhagen. It is considered a strategically located seaport hub at the North end of the Canal, on the newly dredged Eastern bypass. This seaport will be equipped with the latest management and database software and all customer EDI requirements. In addition, it will offer the latest technology of gantries, equipment and enough draft (16.5m) to accommodate the large Motherships of the new generation. The author foresees that the whole Eastern Mediterranean seaports market will be affected upon the commencement of operations of this seaport.

6.4.5 Alexandria seaport

The seaport of Alexandria received higher than average scores in only six criteria, namely, geographic location, proximity, local cargo volumes, low cost, labour relations, and political issues. This places Alexandria at a disadvantage with respect to serving as an Eastern Mediterranean hub, in comparison to Limassol, Piraeus, Damietta and Port Said.

The main strength of the seaport of Alexandria is its location since it provides almost zero deviation for the mothership as well as the local volume cargoes. Alexandria also offers a low comparable tariff but not to the same extent as Damietta. Moreover, labour relations are good with no industrial disputes being recorded. Also, no political issue has ever been recorded as affecting the decision of any Liner operator. The geographic proximity to the regional seaports is good and regarded above average. However, the terminal is very congested due to lack of space. The seaport is bordering the city, which restricts expansion.

Alexandria has both land and sea access. Inland transport is acceptable for domestic cargoes. The low rating may reflect the fact that no shipments are carried through the land towards other countries. Furthermore, labour within the seaport of Alexandria is not particularly skilful. Many instances of damage to containers have been recorded; which partly explains the low rating. Moreover, turnaround of the mothership is average to slow. The problem of congestion as well as the unskilled labour influence productivity. Again, the rating is much lower than average.

Alexandria needs improvements in the areas of terminal space, responsiveness of landlord, equipment handling, and quick turnaround. Improvements are also needed in the areas of

labour capability. Overall, Alexandria appears to require more improvements than other seaports in that its ratings are often well below average. It is thus necessary for the Egyptian authorities to take significant measures such as privatization, in order to improve the suitability of their seaport as a hub in the Eastern Mediterranean.

Regarding transhipment activities, as shown by the rating, Alexandria is not considered to be acting as an understanding landlord. The seaport is lacking the necessary flexibility as well as the marketing policy needed to attract new business. Moreover, the handling equipment is mostly old and insufficient in numbers. There are three gantries, which can be considered as poor, hence the very low rating.

Alexandria is considered to be an experienced seaport in transhipment operations. However, in the last four years, this activity has become less important. Not many lines trust the capability of this seaport today in the same way they did in the past. Furthermore, there is no satisfactory telecommunication infrastructure. It is also important to note that the feedering connections criterion was rated less than average.

6.4.6 Haifa seaport

The seaport of Haifa is less rated, compared to Damietta, Piraeus, Limassol and Port Said. However, it is the authors view, that Haifa, may be the only suitable seaport hub in the Eastern Mediterranean that is less exploited in relation to its true potential.

The high rating on labour can be explained by the fact that labour within the seaport of Haifa is very skilful and well organised. Moreover, Haifa today has become very aggressive in

acquiring new business. As a result, management has become more eager to listen and bridge collaboration with Liner operators.

Furthermore, the high rating on handling equipment is due to the fact that there is an optimum number of gantries so that a minimum of two gantries can be provided per mothership. Other handling equipment is regarded up-to-date and adequate in numbers.

Regarding the below average ratings, the geographic location of Haifa is less advantageous than that of the Egyptian seaports. Also, respondents appear not to be satisfied with the terminal space. The same applies to land and sea access and cost. There are no cargoes carried through the land towards other neighbouring countries.

Haifa does not have the track history of a reputable seaport hub, and its rating in transhipment capabilities is below average. With some improvements, it can be regarded a serious and capable candidate within the region.

With respect to labour relations, industrial disputes have been recorded and unions are considered extremely strong and in full control of the labour market. A more serious problem exists in the area of feedering and political issues. Due to the Arab-Israeli relations, many Liner operators are less eager to consider any of the Israeli seaports as a potential hub. Furthermore, the seaport is experiencing periodical heavy congestions due to long procedural security formalities, although this has recently improved.

Regarding the seaport of Haifa, improvements are needed in the availability of terminal space, feedering connections, and cost. Haifa is negatively affected by politics but again this

is considered an uncontrollable factor. Major improvements are needed with respect to the power of labour unions, in an attempt to adjust to the needs of the market. In addition, further action is required to regain flexibility over various procedures causing congestion. However, it is the Authors view that Haifa may be regarded as the only seaport hub in the Eastern Mediterranean that takes less advantage of the cargo volume that generates. Provided peace emerges in the horizon the true potential of this seaport is expected to flourish.

Overall, the weighted average ratings of seaports indicate that Damietta is considered to be the best candidate for the role of the seaport hub in the region. Damietta is followed closely by Piraeus, Limassol and Port Said. The remaining two seaports appear to have the potential to a lesser extent. However, this situation could change in the future as all seaports in the region strive to correct their weaknesses and improve their market position. Those seaports that will improve on their negative points will increase their business activity while those which do not will suffer the consequences.

In Chapter 7 the author employs the ACTT (average cargo transit time) as a measure of comparison amongst Eastern Vs centrally located hubs through a simulation model.

7. A SIMULATION OF TRANSIT TIMES: CENTRAL V EASTERN MEDITERRANEAN SEAPORT HUBS

In this chapter the author employs a simulation technique to seek the ACTT average cargo transit time by comparing routes via centrally and via Eastern Mediterranean seaport hubs for cargoes originating from the Far East and destined to the Eastern Mediterranean. The model used considers the cargo transportation procedure from the departure seaport (Far-East) until the final destination seaport (East-Med). The simulation describes a series of parameters such as the seaports operational and geographical status as well as feeder schedules, speed of vessels, turnround times, cargo volumes, distance, destinations etc. In this way, the model may be adapted to alternative hub choices and allow for the attainment of comparable transit times. The Eastern Mediterranean seaport hubs under investigation Damietta, Piraeus, Limassol - are compared with centrally located seaport hubs namely Gioia Tauro. It appears that a transit time of almost seven days may be saved if Damietta is chosen instead of Gioia

Tauro. The simulation model allows for changes in the variable parameters e.g. volume, speed etc thus questions of the type "what if" question may be answered.

On the same ground Frankel (1999) has produced a simulation model involving the time-risk-cost element of a simple land-sea-land transport network. More precisely, Frankel (1999) employed a model measuring cost of the time, including risk factors, of major activities taking place between inland and transocean inland points. This approach provides a way to achieve cost effectiveness in supply chain operations. In addition it offers a corrective action in order to achieve a desired schedule with the associated costs. The main differences from the simulation employed by the author are summarized in the following three points:

1. The author proposal considers a transhipment strategy without involvement of inland transit activities. (Origin seaport hub to regional seaport hub to destination feedered seaports).
2. Takes into account the volume of cargo in transit per activity involved.
3. Most importantly the model concentrates on the time element solely. This is in fact the core essence of this thesis.

7.1 Rationale, Aims and Objectives

Until now, the most suitable seaport hubs in the Eastern Mediterranean have been identified, namely Damietta, Piraeus, Limassol and Port Said. Furthermore, it has been argued in previous chapters that transit time is a crucial element in supply chain competitiveness. In this respect, the author wishes to quantify this element subject to alternative hub choices in the Mediterranean. More precisely, the author focuses on the cargo transit time taken from departure seaports (Far East) until final seaport destination (Eastern Mediterranean). In effect,

Table 7.1: Parametric variables and their assumed probability distribution

Parametric Variables	**Probability Distribution**
• Mothership speed (knots)	Normal
• Cargo volumes (number of containers)	Normal
• Mothership time to berth and ready for operations (hours)	Log Normal
• Mothership Rate of unloading at hub (containers/hour)	Normal (approximation to Poisson)
• Feeder availability and time to berth and ready for operations (hours)	Log Normal
• Feeders loading rate at hub (container/hour)	Normal (approximation to Poisson)
• Feeder speed (knots)	Normal
• Feeders waiting to berth and ready for operations at each destination seaport (hours)	Log Normal
• Feeders unloading rate at each destination seaport (containers hour)	Normal (approximation to Poisson)
• Feeders unforeseen delays (hours)	Log Normal

this will help determine the transit times amongst the alternative seaport hub choices within the Mediterranean region under investigation. To achieve this, a simulation model is built. The model considers the cargo transportation procedure from departure seaports in the Far East until final seaport destination in the Eastern Mediterranean.

As a first step, the simulation describes the operational and geographical status currently prevailing, i.e. seaport hubs used, feedered seaports served, feeder schedules, speed of vessels, turnaround times, cargo volumes, distances, etc. In this way, the model may adapt to alternative seaport hub choices and obtain comparable transit times.

7.2 Methodology

The transit time process was segmented into several critical nodes within which certain parametric variables were considered. The following is a list of these nodes:

Table 7.2: Percentage Cargo volume destined at each seaport
Note: The % cargo volume is assumed normal with the stated mean and standard deviation fixed at 1% for all seaports

Seaports	Mean
Limassol	6%
Beirut	6%
Mersin	8%
Lattakia	9%
Izmir	11%
Piraeus	18%
Haifa	20%
Damietta	22%

1) Mothership departs from a Far East mega hub seaport with cargo destined to the Eastern Mediterranean.

2) Arrival of mothership at a Mediterranean hub, where Eastern Mediterranean cargo is discharged.

3) Transhipment activities take place at the seaport hub and thereafter feederships carry the cargoes to final seaport destinations.

7.2.1 Nodes and the Parameters Involved

1) Motherships depart from a Far East Mega hub seaport with cargo destined to the Eastern Mediterranean

The model starts from the point in time where a mothership departs from the Far East. Three mega hubs have been chosen from the Far East, namely, Kaohsiung, Hong-Kong and Singapore as geographical points where motherships depart, see Appendix XVIII. It is acknowledged that other mega-hub seaports exist in the Far East, however, the majority of motherships call at these seaports hubs as part of their few stoppages and, in addition, two of these seaport hubs, namely Hong Kong and Kaoshiung, are situated at the centre of the Far East region. In the model, the origin mega hub is chosen randomly. Furthermore, any

mothership stoppages along the voyage towards the Mediterranean are not encountered directly. This is because it is considered to be a common and equal delay for all motherships.

The variables considered in this node are

a) Cargo volume destined for the Eastern Mediterranean

b) Mothership speed.

Both of these variables are assumed to be stochastic (see Table 7.1).

2) Arrival of mothership at a Mediterranean hub, where Eastern Mediterranean cargo is discharged.

The Eastern Mediterranean seaport hubs under investigation are Damietta, Piraeus and Limassol. These are compared with a centrally located seaport hub, namely Gioia Tauro. The latter was chosen as the main and biggest transhipment hub in the central Mediterranean. It is noted that other centrally located hubs, e.g. Marsaxlokk and Taranto, are in close proximity to Gioia Tauro.

Upon arrival of the mothership at the hub, the vessel enters the seaport and requires an average of two hours to berth and commence operations. The containers are discharged and the rate of unloading depends on the efficiency of the seaport but most importantly on the number of gantry cranes utilized.

The variables considered here are:

a) mothership time to berth and commence operations;

b) rate of container discharged (see Table 7.1).

3) Transhipment activities take place at the seaport hub and thereafter feederships carry the cargoes to final seaport destinations

It is assumed that two schedule routes may serve the Eastern Mediterranean seaport market, namely Piraeus, Izmir, Mersin, Limassol, Lattakia, Beirut, Haifa and Damietta. The author selected the most rational routes after consultation with Sarlis, (being one of the major players in the Mediterranean.Liner traffic).

Feederships expected to arrive at the hub, enter the berth and commence loading operations. This process was estimated to take an average of 3 days. More specifically, the author considered the schedules of various operators that included feedership availability, hub berth availability, and time of commencement of operations. Finally, upon berthing the feeders are loaded. Loading rate depends on hub efficiency and the cranes utilized.

The feeders commence their voyage subject to a specific schedule. The speed of the feeders is accounted for. At each destination seaport a feeder may experience delays in berthing and preparing for operations. In addition, the unloading rate at the destination seaports is accounted for. Moreover, the author takes in to account possible unforeseen delays that feederships can experience, e.g. long queues at Haifa Seaport, strikes, etc. Following consultation with Hapag-Lloyd, the percentage of cargo volume per destination seaport is as given in Table 7.2

The variables considered in this node are:

i) Feedership availability, arrival and berthing at hub.

ii) Feedership loading rate at hub.

iii) Feedership speed.

iv) Feedership arrival and berthing at each destination seaport.

v) Feedership unloading rate at destination seaports.

vi) Feedership' unforeseen delays.

The last seaport of destination of the feedership is considered to be the final stage of the model. At that stage the Average Cargo Transit Time (ACTT) is calculated,

$$ACTT = \frac{\sum_{i^{th}\ \text{port}} C_i T_i}{\sum_{i^{th}\ \text{port}} C_i} \tag{7.1}$$

where C_i is the cargo (measured in number of containers) still in transit (while on board the vessel) up to the i^{th} seaport shipped from the Far East, T_i is the time taken to discharge the cargo at each i^{th} port. Note that $\sum_{i^{th}\ \text{port}} C_i$ is the total cargo shipped to the Eastern Mediterranean from the Far East. The ACTT is, in fact, a weighted average of the time taken to deliver cargo at all seaports in the Eastern Mediterranean. The number of cargo containers still in transit up to the i^{th} seaport, i.e. C_i is the weight imposed on time.

In the simulation, this calculation (Equation (7.1)) is carried out at the end of each iteration. At the final stage of the whole simulation the ACTTs obtained are used to produce an average ACTT. Also the standard error of the ACTT is calculated at this stage.

Example:

An example of one iteration of the simulation is demonstrated in Table 7.3 below.

Table 7.3: Example of Simulation
Source: Calculated by author

Procedure	**Cargo Transit Time (hr) per Procedure T_i (hr)**	**Weight C_i (cont)**	**ACTT Contribution (hr) T_iC_i (hr × cont)**
Mothership Voyage Hong Kong → Damietta	$\frac{6500 \text{ n.m.}}{22 \text{ kn}} = 295.5$ hr	3000	886500
Mothership Berthing at Damietta	2 hrs	3000	6000
Mothership Unloading at Damietta	$\frac{3000 \text{ cont}}{60 \text{ cont/hr}} = 50$ hr	3000	150000
Feeder A (Damietta → Limassol → Piraeus → Izmir Volumes: Limassol = 6% × 3000 cont=180 cont Piraeus = 18% × 3000 cont=540 cont Izmir = 11% × 3000 cont=330 cont			
Loading	$\frac{(180+540+330)\text{cont}}{30 \text{ cont/hr}} = 35$ hr	1050	36750
Voyage Damietta → Limassol	$\frac{208 \text{ n.m.}}{14 \text{ kn}} = 14.9$ hr	1050	15645
Berthing at Limassol	10hr	1050	10500
Unloading at Limassol	$\frac{180 \text{ cont}}{30 \text{ cont/hr}} = 6$ hr	1050	6300
Voyage Limassol → Piraeus	$\frac{525 \text{ n.m.}}{14 \text{ kn}} = 37.5$ hr	870	32625

Table 7.3 (continued): Example of Simulation

Berthing at Piraeus	10hr	870	8700
Unloading at Piraeus	$\frac{540 \text{ cont}}{30 \text{ cont/hr}} = 18 \text{ hr}$	870	15660
Voyage Piraeus → Izmir	$\frac{352 \text{ n.m.}}{14 \text{ kn}} = 25.1 \text{ hr}$	330	8283
Berthing at Izmir	10hr	330	3300
Unloading at Izmir	$\frac{330 \text{ cont}}{30 \text{ cont/hr}} = 11 \text{ hr}$	330	3630
Feeder B (Damietta → Haifa → Beirut → Lattakia → Mersin Volumes: Haifa = 20% × 3000 cont=600 cont Beirut = 6% × 3000 cont=180 cont Lattakia = 9% × 3000 cont=270 cont Mersin = 8% × 3000 cont=240 cont			
Loading	$\frac{(600+180+270+240)\text{cont}}{30 \text{ cont/hr}} = 43 \text{ hr}$	1290	55470
Voyage Damietta → Haifa	$\frac{175 \text{ n.m.}}{14 \text{ kn}} = 12.5 \text{ hr}$	1290	16125
Berthing at Haifa	10hr	1290	12900

Table 7.3 (continued): Example of Simulation

Unloading at Haifa	$\frac{600 \text{ cont}}{30 \text{ cont/hr}} = 20 \text{ hr}$	1290	25800
Voyage Haifa $\rightarrow$ Beirut	$\frac{72 \text{ n.m.}}{14 \text{ kn}} = 5.1 \text{ hr}$	690	3519
Berthing at Beirut	10hr	690	6900
Unloading at Beirut	$\frac{180 \text{ cont}}{30 \text{ cont/hr}} = 6 \text{ hr}$	690	4140
Voyage Beirut $\rightarrow$ Lattakia	$\frac{100 \text{ nm}}{14 \text{ kn}} = 7.1 \text{ hr}$	510	3621
Berthing at Lattakia	10hr	510	5100
Unloading at Lattakia	$\frac{270 \text{ cont}}{30 \text{ cont/hr}} = 9 \text{ hr}$	510	4590
Voyage Lattakia $\rightarrow$ Mersin	$\frac{94 \text{ nm}}{14 \text{ kn}} = 6.7 \text{ hr}$	240	1608
Berthing at Mersin	10hr	240	2400
Unloading at Mersin	$\frac{240 \text{ cont}}{30 \text{ cont/hr}} = 8 \text{ hr}$	240	1920
Feeders Unforeseen Delays	48hr	2340	112320
Feeder Availability	72hr	2340	168480
			$\text{ACTT} = \frac{1608786 \text{ hr} \times \text{cont}}{3000 \text{ cont}}$ $= 536.3 \text{ hr or } 22.3 \text{ days}$

Table 7.4: Scheduled Routes as used in the Simulation Model

HUB: LIMASSOL		
Schedule	**Feeder A**	**Feeder B**
1.	Limassol→Piraeus→Izmir	Limassol→Damietta→Haifa→ →Beirut→Lattakia→Mersin
2.	Limassol→Piraeus→Izmir	Limassol→Mersin→Lattakia→ →Beirut→Haifa →Damietta
3.	Limassol→ Izmir →Piraeus	Limassol→Mersin→Lattakia→ →Beirut →Haifa →Damietta
4.	Limassol→ Izmir →Piraeus	Limassol→Damietta→Haifa→ →Beirut→Lattakia→Mersin
5.	Limassol→Damietta→Piraeus→Izmir	Limassol→Haifa→Beirut→ →Lattakia→Mersin
6.	Limassol→Damietta→Piraeus→Izmir	Limassol→Mersin→Lattakia →Beirut →Haifa
7.	Limassol→Damietta→Izmir →Piraeus	Limassol→Haifa→Beirut→ →Lattakia→Mersin
8.	Limassol→Piraeus→Izmir→Damietta	Limassol→Haifa→Beirut→ →Lattakia→Mersin
9.	Limassol→ Izmir→Piraeus→Damietta	Limassol→Haifa→Beirut→ →Lattakia→Mersin
HUB: DAMIETTA		
Schedule	**Feeder A**	**Feeder B**
1.	Damietta→Piraeus→Izmir	Damietta→Limassol→Haifa→ →Beirut→Lattakia→Mersin
2.	Damietta→Piraeus→Izmir	Damietta→Haifa→Beirut→ →Lattakia→Mersin→Limassol
3.	Damietta→Piraeus→Izmir	Damietta→Limassol→Mersin→ →Lattakia→Beirut→Haifa
4.	Damietta→Izmir→Piraeus	Damietta→Limassol→Haifa→ →Beirut→Lattakia→Mersin
5.	Damietta→Izmir→Piraeus	Damietta→Haifa→Beirut→ →Lattakia→Mersin→Limassol
6.	Damietta→Izmir→Piraeus	Damietta→Limassol→Mersin→ →Lattakia→Beirut→Haifa
7.	Damietta→Limassol→Piraeus→Izmir	Damietta→Haifa→→Beirut→ →Lattakia→Mersin
8.	Damietta→Limassol→Izmir→Piraeus	Damietta→Haifa→→Beirut→ →Lattakia→Mersin
9.	Damietta→Piraeus→Izmir→Limassol	Damietta→Haifa→→Beirut→ →Lattakia→Mersin
10.	Damietta→Izmir→Piraeus→Limassol	Damietta→Haifa→→Beirut→ →Lattakia→Mersin

Table 7.4 (continued): Scheduled Routes as used in the Simulation Model

HUB: PIRAEUS		
Schedule	**Feeder A**	**Feeder B**
1.	Piraeus→Izmir→Limassol→Damietta	Piraeus→Haifa→Beirut→ →Lattakia→Mersin
2.	Piraeus→Izmir→Limassol→Damietta	Piraeus→Mersin→Lattakia →Beirut→Haifa
3.	Piraeus→Izmir→Damietta	Piraeus→Limassol→Haifa→ →Beirut→Lattakia→Mersin
4.	Piraeus→Limassol→Damietta	Piraeus→Izmir→Mersin→ →Lattakia→Beirut→Haifa
HUB: GIOIA TAURO		
Schedule	**Feeder A**	**Feeder B**
1.	G.Tauro→Piraeus→Izmir	G.Tauro→Limassol→Damietta→ →Haifa→Beirut→Lattakia→Mersin
2.	G.Tauro→Piraeus→Izmir	G.Tauro→Damietta→Limassol→ →Haifa→Beirut→Lattakia→Mersin
3.	G.Tauro→Piraeus→Izmir	G.Tauro→Damietta→Haifa→ →Limassol→Beirut→Lattakia→Mersin
4.	G.Tauro→Piraeus→Izmir	G.Tauro→Mersin→Lattakia→ →Beirut→Haifa→Damietta→Limassol
5.	G.Tauro→Piraeus→Izmir	G.Tauro→Mersin→Lattakia→ →Beirut→Haifa→Limassol→Damietta
6.	G.Tauro→Piraeus→Izmir→Mersin	G.Tauro→Limassol→Damietta→ →Haifa→Beirut→Lattakia
7.	G.Tauro→Piraeus→Izmir→Mersin	G.Tauro→Damietta→Limassol→ →Haifa→Beirut→Lattakia
8.	G.Tauro→Piraeus→Izmir→Mersin	G.Tauro→Damietta→Haifa→ →Limassol→Beirut→Lattakia
9.	G.Tauro→Piraeus→Izmir→Mersin	G.Tauro→Lattakia→Beirut→ →Haifa→Damietta→Limassol
10.	G.Tauro→Piraeus→Izmir→Mersin	G.Tauro→Lattakia→Beirut→ →Haifa→Limassol→Damietta

7.3 Simulation Results

The simulation was run for each hub for 100 iterations. The results are discussed below. The parameter values used in each case are shown in Table 7.5.

Table 7.5: Simulation Parameter values for all hubs.
(* value used solely for Gioia Tauro)

	Mean	St.Dev
Mothership speed. (knots)	22	1
Mothership berthing (hours)	2	0.5
Mothership rate of unloading (containers per hour)	90* 60	
Feeders availability and berthing at hub (excluding loading)	72 (Hrs)	12
Feeders loading rate at hub (containers per hour)	30	
Feeder speed (knots)	14	1
Feeders waiting to berth at each destination (hours)	10	2
Feeders unloading rate at destination seaport (container per hrs)	30	
Feeders unforeseen delays (hours)	48	12
Mothership Cargo Volume Discharged (containers)	3000	250

Gioia Tauro seaport hub

It appears that the best ACTT (average cargo transit time) is offered by route 8 with 24.6 days and a standard error of 0.3, see Table 7.6. From this a 95% confidence interval[35] can be estimated as follows:

$$(24.6-1.96\times 0.3,\ 24.6\ +1.96\times 0.3)=(24.01,\ 25.18) \qquad (7.2)$$

Damietta seaport hub

It appears that the best ACTT is offered by route 7 with 18.1 days and a standard error of 0.2, see Table 7.6. From this a 95% confidence interval can be estimated as follows:

$$(18.1-1.96\times 0.2,\ 18.1+1.96\times 0.2)=(17.70,\ 18.49) \qquad (7.3)$$

Piraeus seaport hub

It appears that the best ACTT is offered by route 1 with 19.8 days and a standard error of 0.3, see Table 7.6. From this a 95% confidence interval can be estimated as follows:

$$19.8-1.96\times 0.3,\ 19.8+1.96\times 0.3=(19.21,\ 20.38) \qquad (7.4)$$

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[35] The formula for the 95% Confidence Interval for the mean of the ACTT is given by $\bar{x}\pm 1.96\times \text{s.e.}$, where $\bar{x}$ is the estimated ACTT and s.e. is the standard error of the estimate.

Figure 7:1: Simulation estimated confidence intervals for each hub

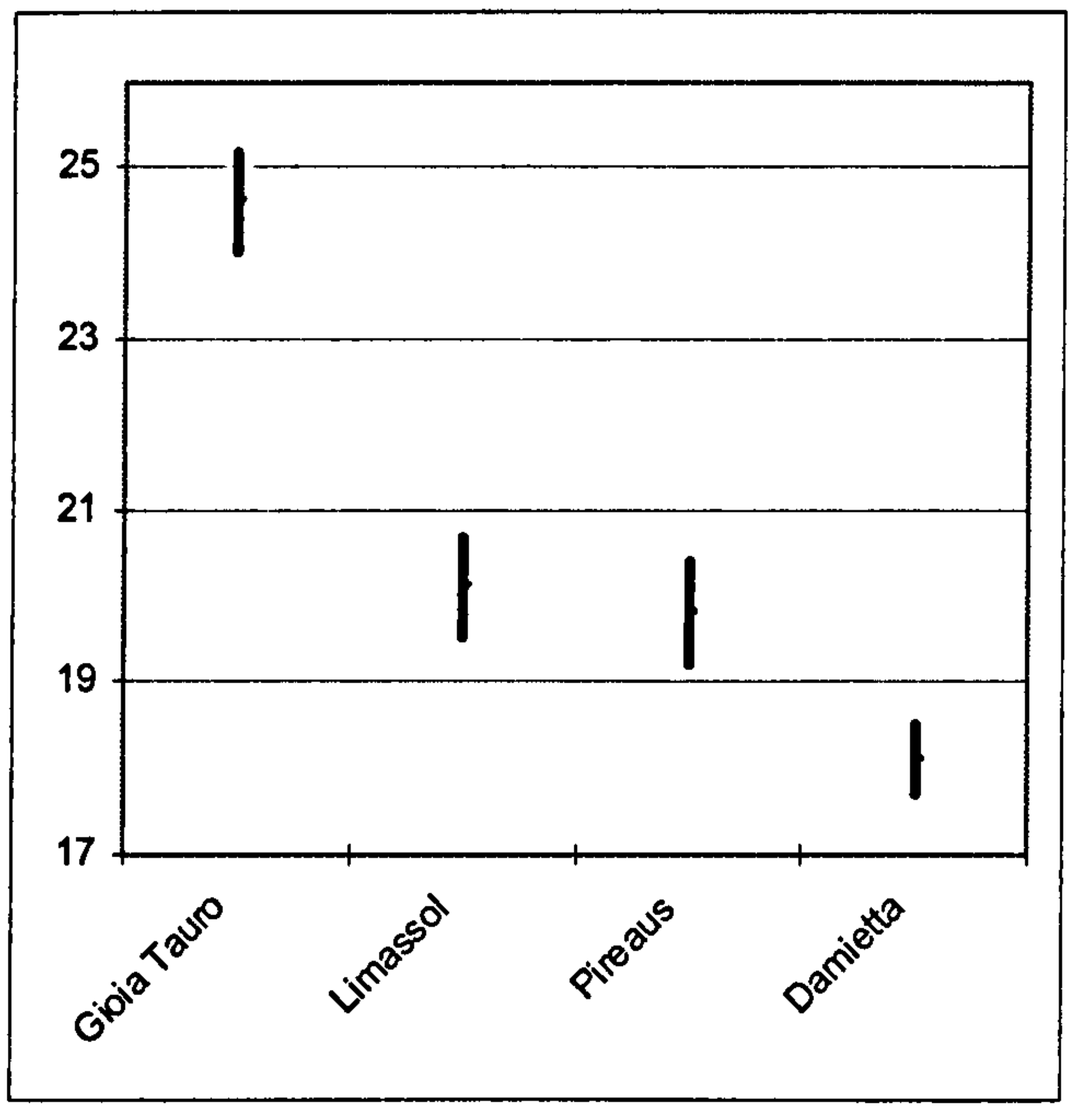


Table 7.6: Simulation Results for each hub
(in days)

	Gioia Tauro		**Damietta**		**Limassol**		**Piraeus**	
Route	ACTT	SE	ACTT	SE	ACTT	SE	ACTT	SE
1	25,7	0.3	18,4	0.2	22,0	0.3	**19,8**	0.3
2	25,2	0.3	18,5	0.2	22,4	0.3	19,9	0.3
3	25,5	0.3	18,5	0.2	22,3	0.3	19,9	0.3
4	25,9	0.3	18,5	0.2	21,7	0.3	21.0	0.3
5	25,4	0.3	18,5	0.2	**20,1**	0.3		
6	25,0	0.3	18,8	0.2	20,2	0.3		
7	25,1	0.3	**18,1**	0.2	20,2	0.3		
8	**24,6**	0.3	18,2	0.2	20,7	0.3		
9	25,0	0.3	18,4	0.2	20,6	0.3		
10	25,0	0.3	18,3	0.2				

Limassol seaport hub

It appears that the best ACTT is offered by route 5 with 20.1 days and a standard error of 0.3, see Table 7.6. From this a 95% confidence interval can be estimated as follows:

$$20.1-1.96\times 0.3,\ 20.1+1.96\times 0.3=(19.51,\ 20.68) \qquad (7.5)$$

7.3.1 Comparison of Results

It appears that the Eastern Mediterranean seaport hubs, namely Damietta-Piraeus-Limassol offer significantly lower ACTT (average cargo transit time) than Gioia Tauro (see Figure 7:1) situated at the central of the Mediterranean. More precisely Damietta offers 6.5 days less ACTT i.e. approximately 26.4% ACTT reduction as compared to Gioia Tauro. On the other hand Piraeus offers 4.8 days less ACTT reflecting 19.5% decrease compared to Gioia Tauro whilst Limassol offers 4.5 less ACTT corresponding to approximately 18.3% decrease.

7.3.2 A Comparison between Eastern Mediterranean seaport hubs

Limassol and Piraeus appear to offer similar ACTT (Piraeus 19.8 and Limassol 20.1), see Table 7.6. The author believes that the reason for this is based mainly on the following 2 reasons: i) Piraeus generates substantially bigger local volumes than Limassol thus ACTT being reduced, while ii) its geographic proximity to the market is less advantageous than the Limassol seaport hub. Damietta obviously offers a significant lower ACTT from both Limassol and Piraeus; a difference of approximately 2 days is indicated.

7.4 "What If" Analysis and Seaport Hubs Recommendations

The simulation allows the analysis of various scenarios in order to identify sensitive or robust features of the hubs under consideration. Each of the parameters has been solely investigated for each hub, by altering their values and estimating the ACTT. The simulation was run for 2500 iterations, a level at which the estimated standard error of the estimates becomes insignificantly small.

Table 7.7: ACTT for each hub subject to variations in the Total Cargo (measured in containers)

	ACTT (days)			
Total Cargo	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
500	21.1	15.3	16.9	16.7
1000	21.9	15.9	17.5	17.5
1500	22.6	16.5	18.1	18.1
2000	23.3	17.1	18.6	18.8
2500	24.0	17.6	19.2	19.5
3000	24.8	18.2	19.8	20.2
3500	25.5	18.7	20.5	20.9
4000	26.2	19.3	21.0	21.6
4500	27.0	19.8	21.6	22.3
5000	27.6	20.5	22.2	23.0
5500	28.4	21.0	22.8	23.7
6000	29.1	21.5	23.4	24.4

Figure 7:2: ACTT v Total Cargo (in containers)

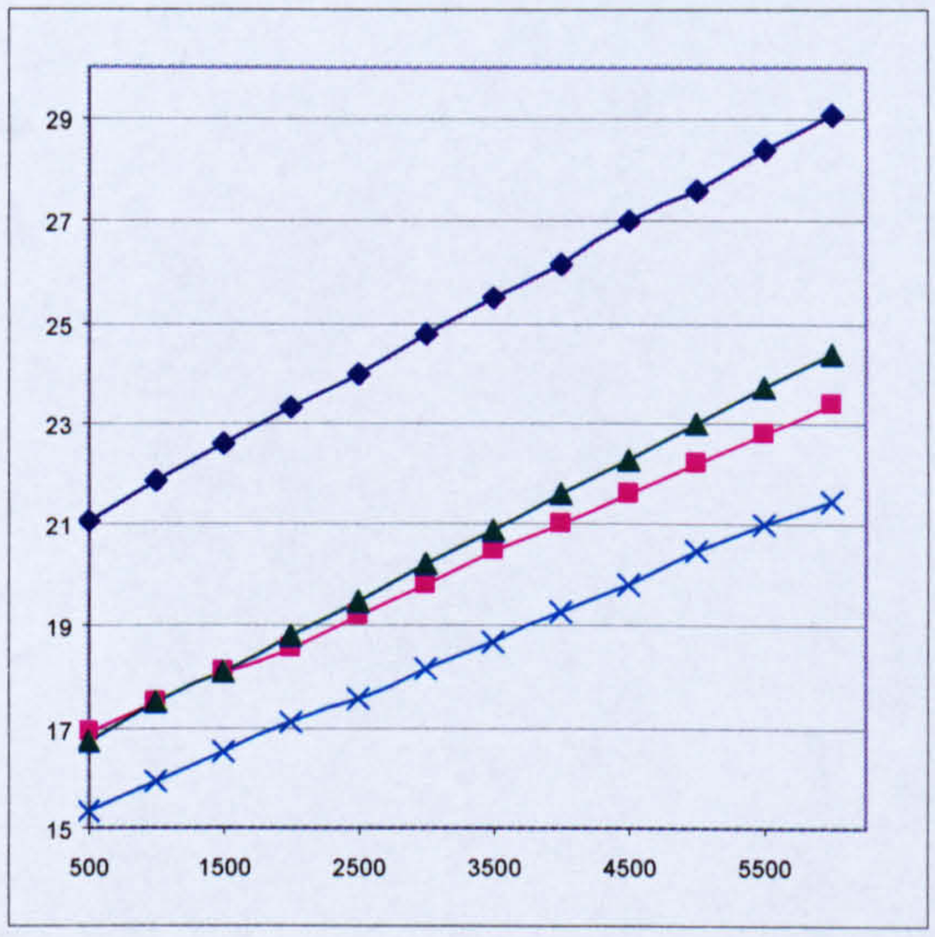
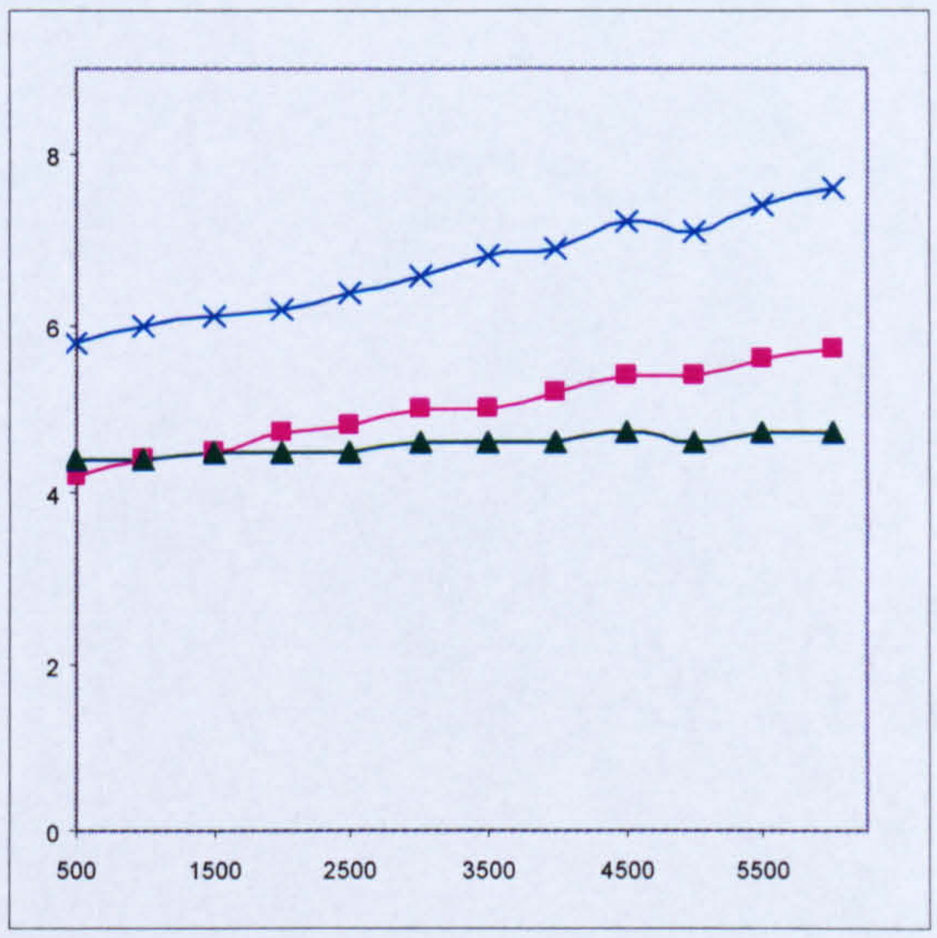
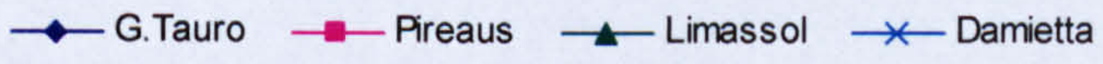


Figure 7:3: Difference of Gioia Tauro ACTT with other hubs v Total Cargo (in containers)





From Figure 7:2 it appears that there is a positive linear relationship between ACTT and total market cargo i.e. as total cargo increases ACTT increases linearly. From Figure 7:3 it can be observed that Damietta has a slightly stronger positive linear relationship as compared to Gioia Tauro, i.e. the bigger the volumes the greater the difference in ACTT between Damietta and Gioia Tauro.

Table 7.8: ACTT for each hub subject to variations in the mothership speed

	ACTT (days)			
Mothership Speed	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
12	36.1	28	30.5	30.3
15	31.0	23.5	25.7	25.7
17	28.7	21.5	23.6	23.6
18	27.8	20.8	22.7	22.8
19	26.8	20.1	21.8	22.1
20	26.1	19.3	21.0	21.3
21	25.4	18.7	20.4	20.9
22	24.8	18.1	19.9	20.3
23	24.2	17.6	19.3	19.7
24	23.6	17.3	18.8	19.2
25	23.2	16.7	18.3	18.7
26	22.7	16.4	17.8	18.4
27	22.3	16.1	17.5	18.0
28	22.0	15.7	17.1	17.6
29	21.5	15.4	16.7	17.3

Figure 7:4: ACTT v Mothership speed (in knots)

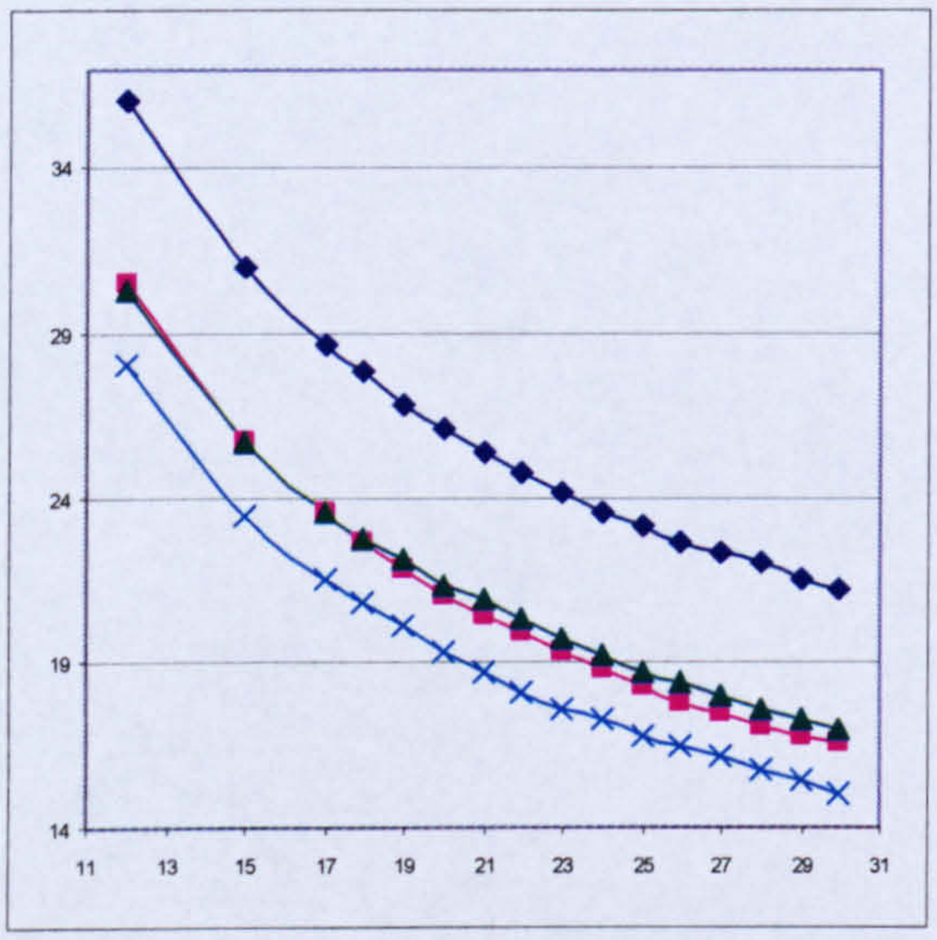
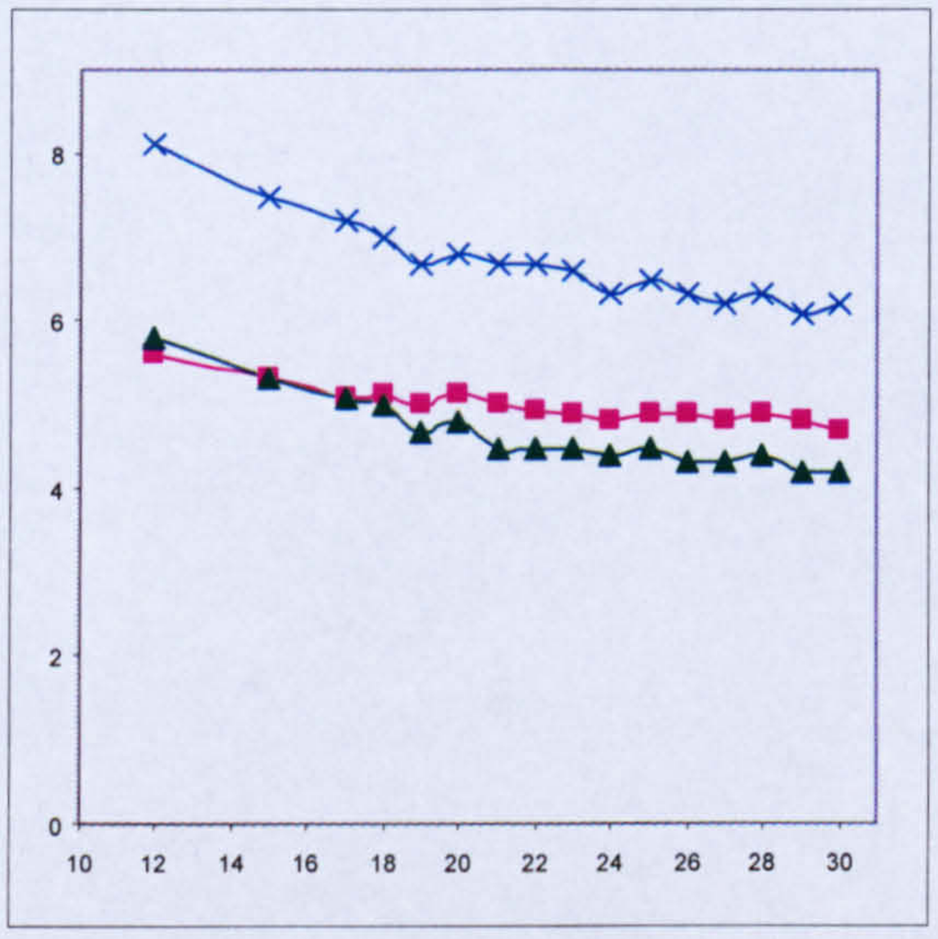
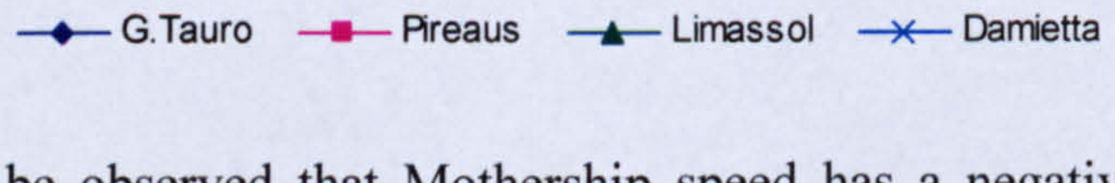


Figure 7:5: Difference of Gioia Tauro ACTT with other hubs v Mothership speed (in knots)





In Figure 7:4 it can be observed that Mothership speed has a negative slightly nonlinear relationship with the ACTT. Furthermore in the Figure 7:5 it is evident that the greater the speed of the Mothership the smaller the difference of ACTT between Damietta, Piraeus, Limassol with Gioia Tauro. This is reasonable since the additional distance covered by a

Table 7.9: ACTT for each hub subject to variations in the Mothership rate of unloading (containers per hour)

	ACTT (days)			
Mothership rate of unloading	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
10	36.4	29.7	32.3	32.6
20	30	22.6	24.4	24.6
30	27.7	20.3	22.1	22.4
40	26.6	19.3	20.8	21.3
50	25.8	18.6	20.2	20.6
60	25.5	18.1	19.8	20.1
70	25.2	17.9	19.5	19.8
80	24.9	17.7	19.3	19.7
90	24.7	17.5	19.1	19.5
100	24.6	17.4	19	19.3
120	24.4	17	18.8	19.1
150	24.1	16.8	18.5	19
180	24	16.7	18.4	18.7

Figure 7:6: ACTT v Mothership rate of unloading (in containers)

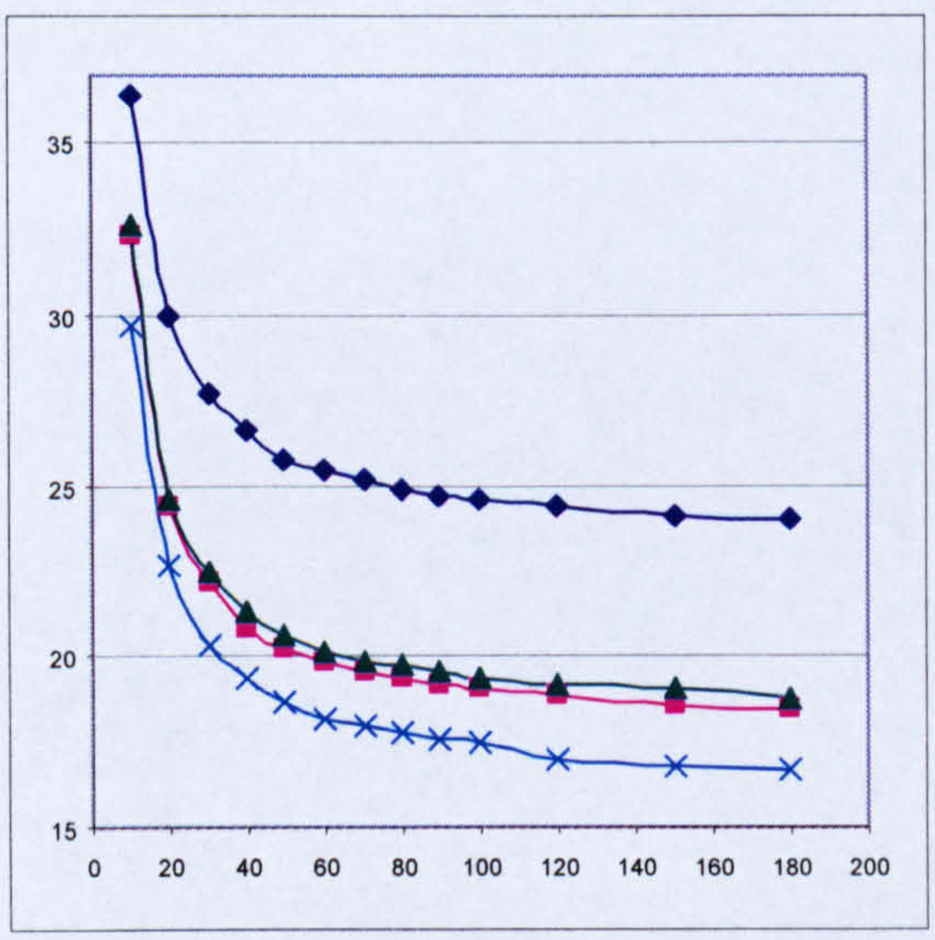
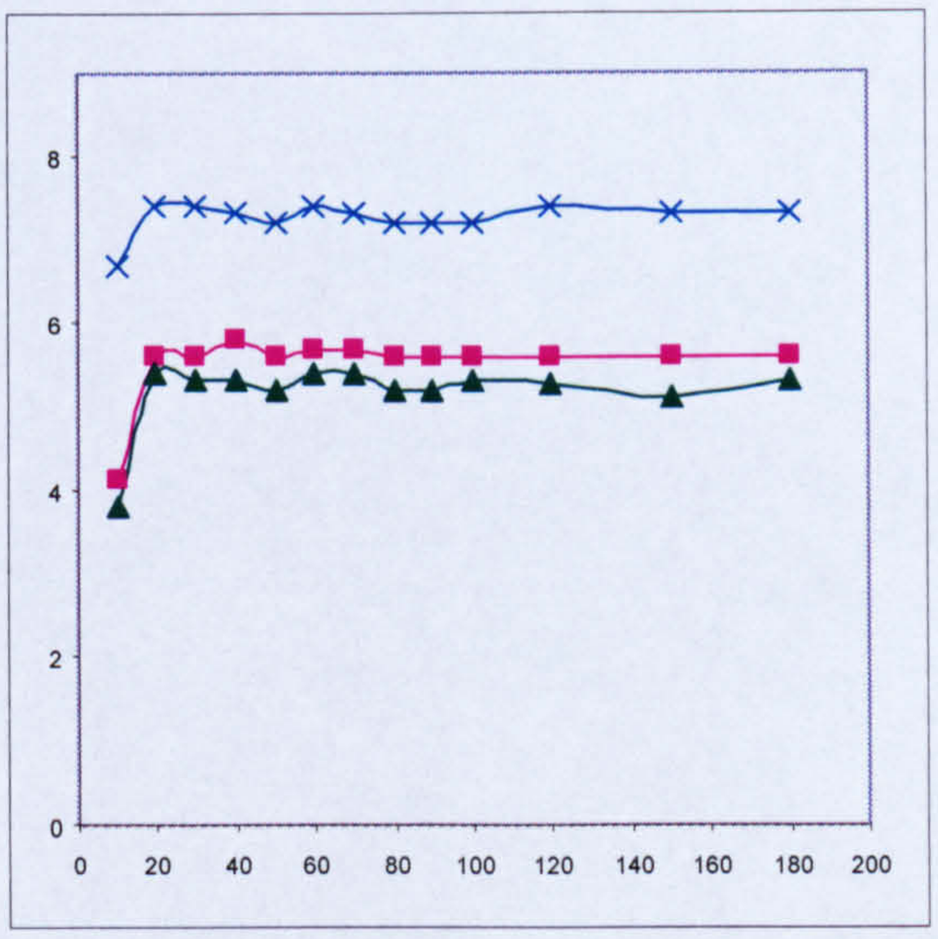


Figure 7:7: Difference of Gioia Tauro ACTT with other hubs v Mothership rate of unloading (in containers)



Mothership to reach Gioia Tauro (960 nautical miles from Suez) takes lesser time when speed increases.

Table 7.10: ACTT for each hub subject to variations in the feedership loading rate at hub (containers per hour)

	ACTT (days)			
Feeder Loading Rate at Hub	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**

10	26.8	18.9	21.4	22.8
20	25.5	18.5	20.2	20.7
30	24.8	18.2	19.7	20.2
40	24.5	18	19.6	19.9
50	24.3	17.9	19.6	19.8
60	24.1	17.9	19.5	19.6
70	23.9	17.8	19.4	19.6
80	23.8	17.8	19.4	19.5
90	23.7	17.7	19.4	19.5
100	23.7	17.7	19.3	19.5

Figure 7:8: ACTT v Feeder Loading Rate at hub
(in containers per hour)

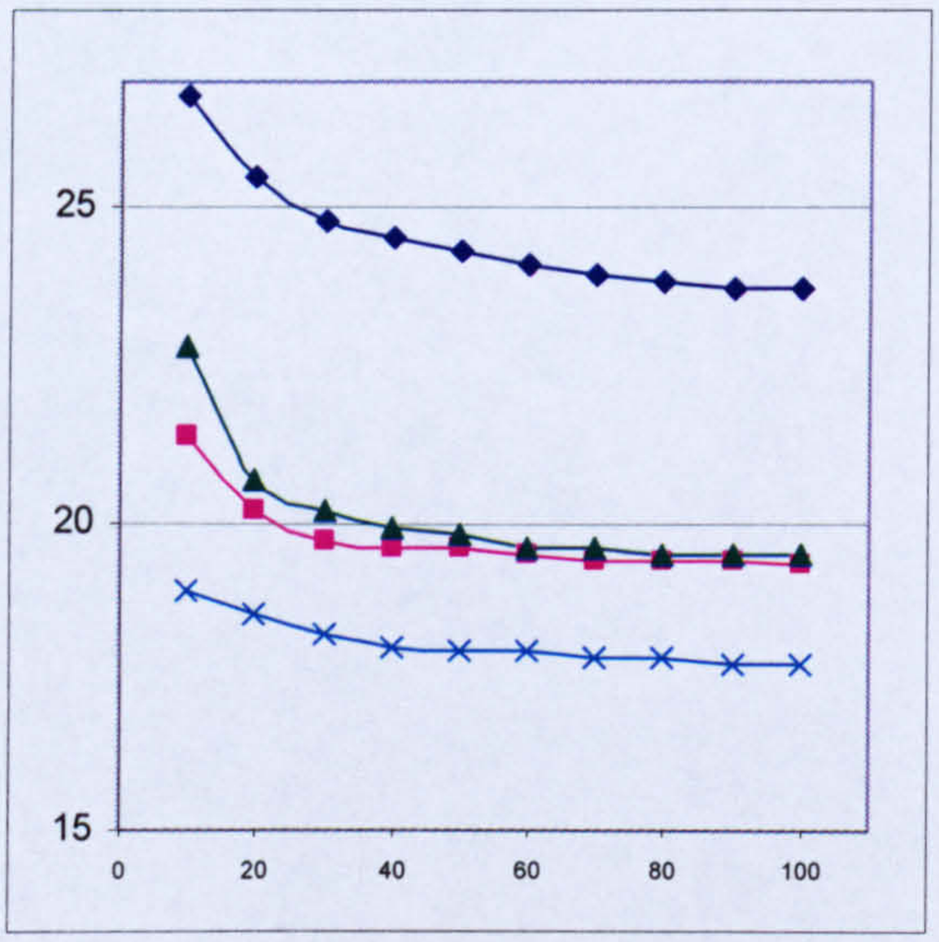
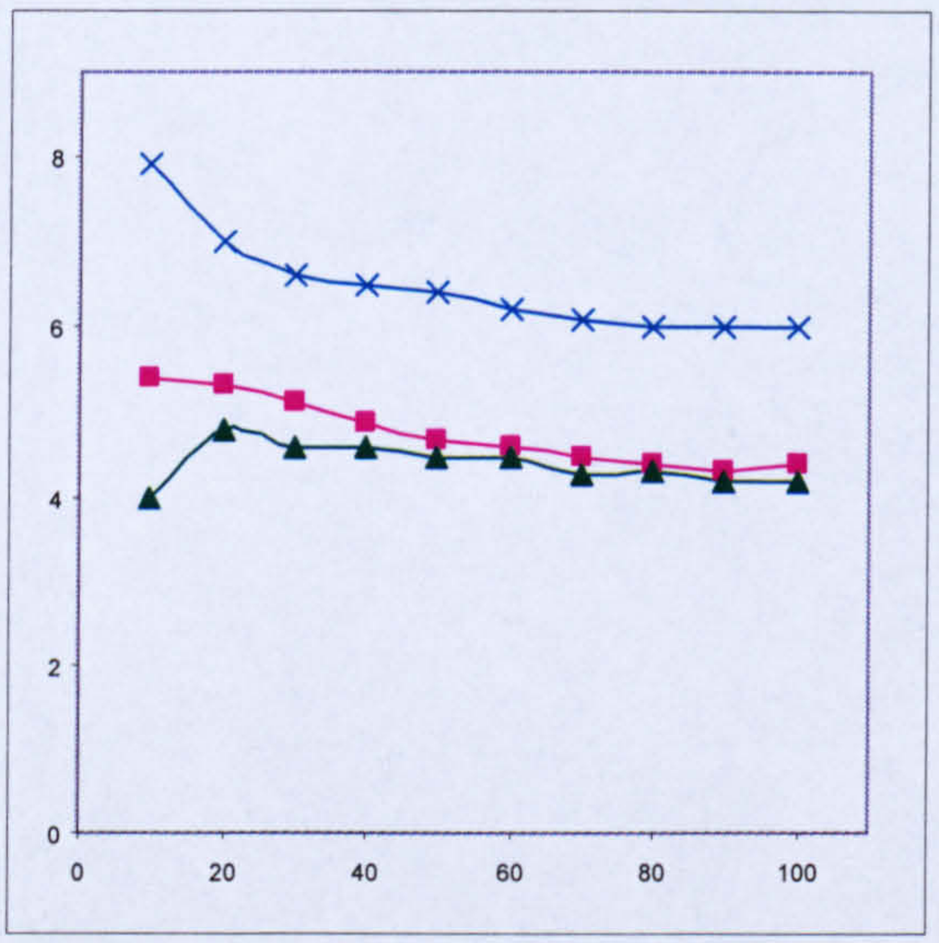


Figure 7:9: Difference of Gioia Tauro ACTT with other hubs v Feeder Loading Rate at hub
(in containers per hour)



In Figure 7:6 a negative nonlinear relationship is observed. In fact it appears that for all seaport hubs handling operation is crucial when discharging (in other words Gantry Crane handling operations) is slow. The author considers that handling moves of 20 or less containers per hour is inefficient in terms of ACTT. On the other hand, even if more productivity (assuming on average total of 3000 containers) is offered may not result in significantly reduction in the ACTT. However, the author does appreciate that even though there may be an insignificant effect on ACTT when better productivity (discharge) is offered, such effect is extremely crucial to the Liner operators.

Table 7.11: ACTT for each hub subject to variations in the feedership unloading rate at destination seaports
(containers per hour)

	ACTT (days)			
Feeder Unloading rate at destination seaports	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
10	28.5	19.6	21.6	22.2
20	25.6	18.5	20.2	20.8
30	24.8	18.2	19.9	20.2
40	24.4	18	19.7	20
60	24	17.8	19.5	19.7
80	23.8	17.8	19.4	19.6
100	23.7	17.7	19.3	19.5

Figure 7:10: ACTT v Feeder unloading rate at destination seaport
(in containers per hour)

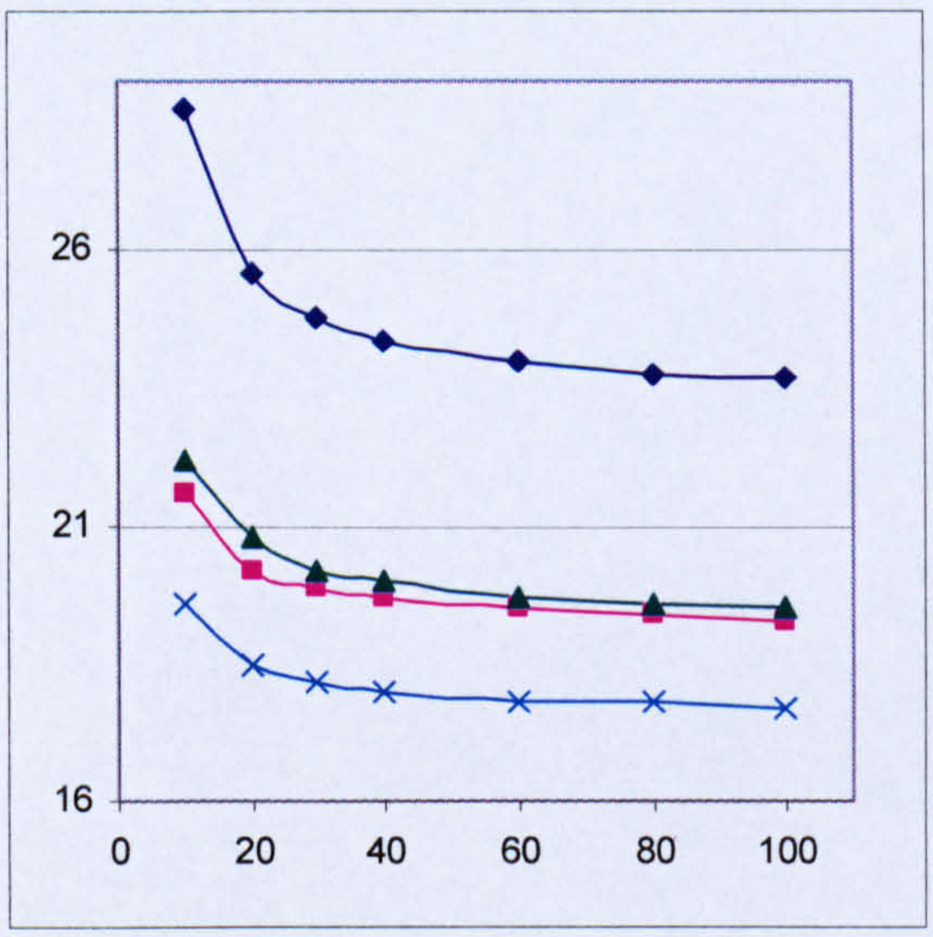


Figure 7:11: Difference of Gioia Tauro ACTT with other hubs v Feeder unloading rate at destination seaport
(in containers per hour)

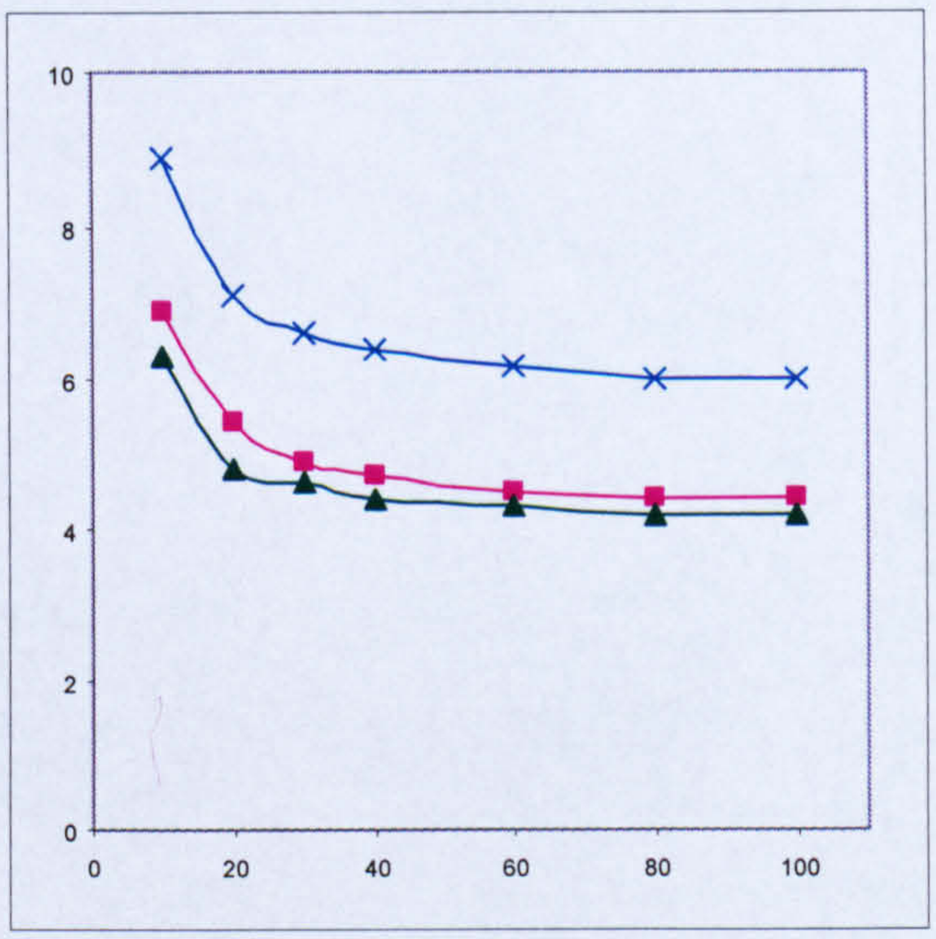


Table 7.12: ACTT for each hub subject to variations in feedership speed (knots)

	ACTT (days)			
Feeder Speed	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
6	29.5	19.5	21.7	21.9
8	27.4	18.9	20.9	21.2
10	26.1	18.6	20.4	20.7
12	25.4	18.3	20	20.4
14	24.8	18.1	19.8	20.1
16	24.4	18.1	19.6	20
18	24	17.9	19.5	19.9
20	23.8	17.8	19.4	19.8
22	23.6	17.8	19.4	19.8

Figure 7:12: ACTT v Feeder Speed (in knots)

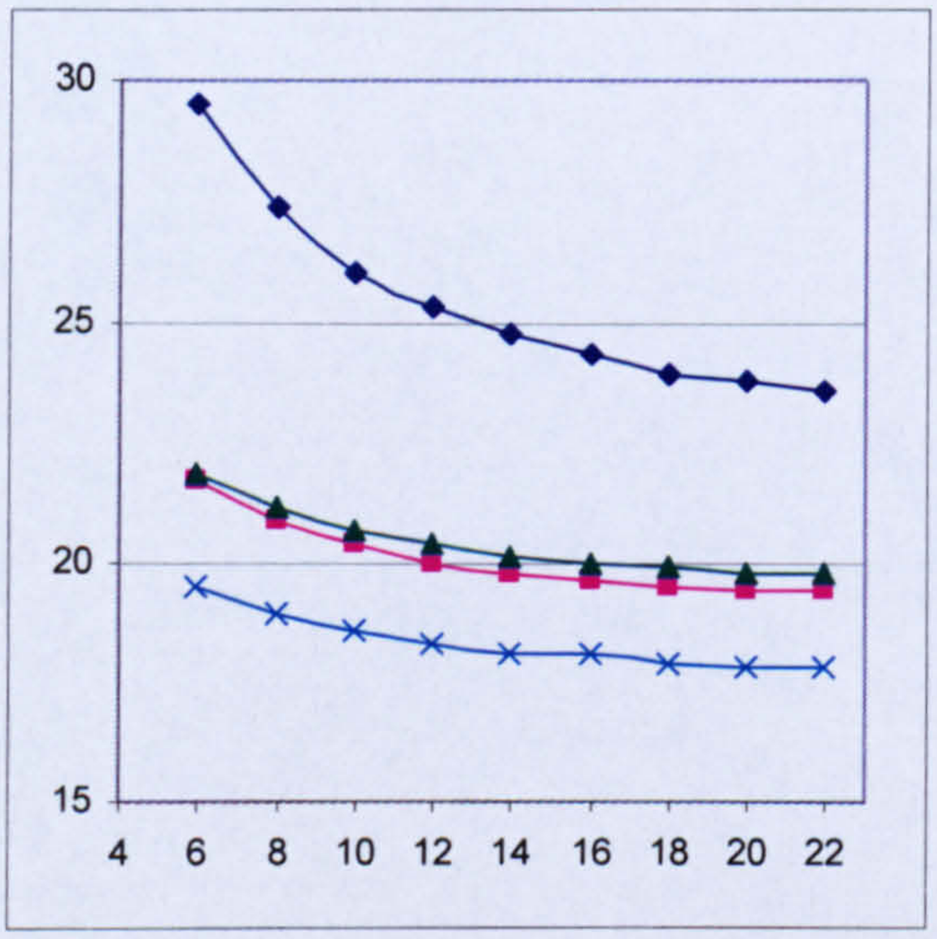
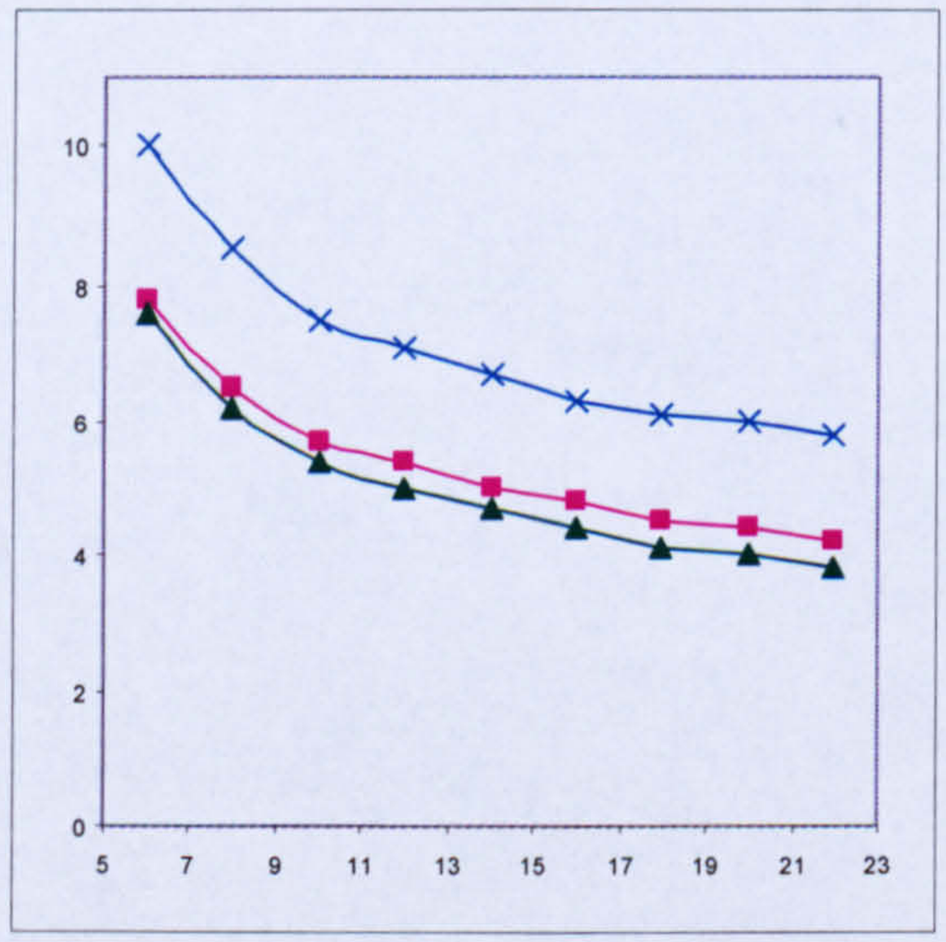


Figure 7:13: Difference of Gioia Tauro ACTT with other hubs v Feeder Speed (in knots)



In relation to Figure 7:7 it can be extrapolated that considering that Gioia Tauro can offer more productive handling operation it does not lead to significant reductions to the ACTT as compared with the other named seaport hubs that currently offer less productivity.

From Figure 7:8 it appears that there is a negative nonlinear relationship. Indicatively for very slow operations (e.g. handling of 10 containers per hour) there is a great increase in the

Table 7.13: ACTT for each hub subject to variations in the Mothership berthing (hours)

	ACTT (days)			
Mothership Berthing	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
1	24.8	18.1	19.8	20.1
2	24.8	18.2	19.8	20.2
3	24.9	18.2	19.8	20.3
4	24.9	18.2	19.9	20.3
6	24.9	18.3	20.0	20.4
10	25.1	18.5	20.2	20.6

Figure 7:14: ACTT v Mothership berthing (in hours)

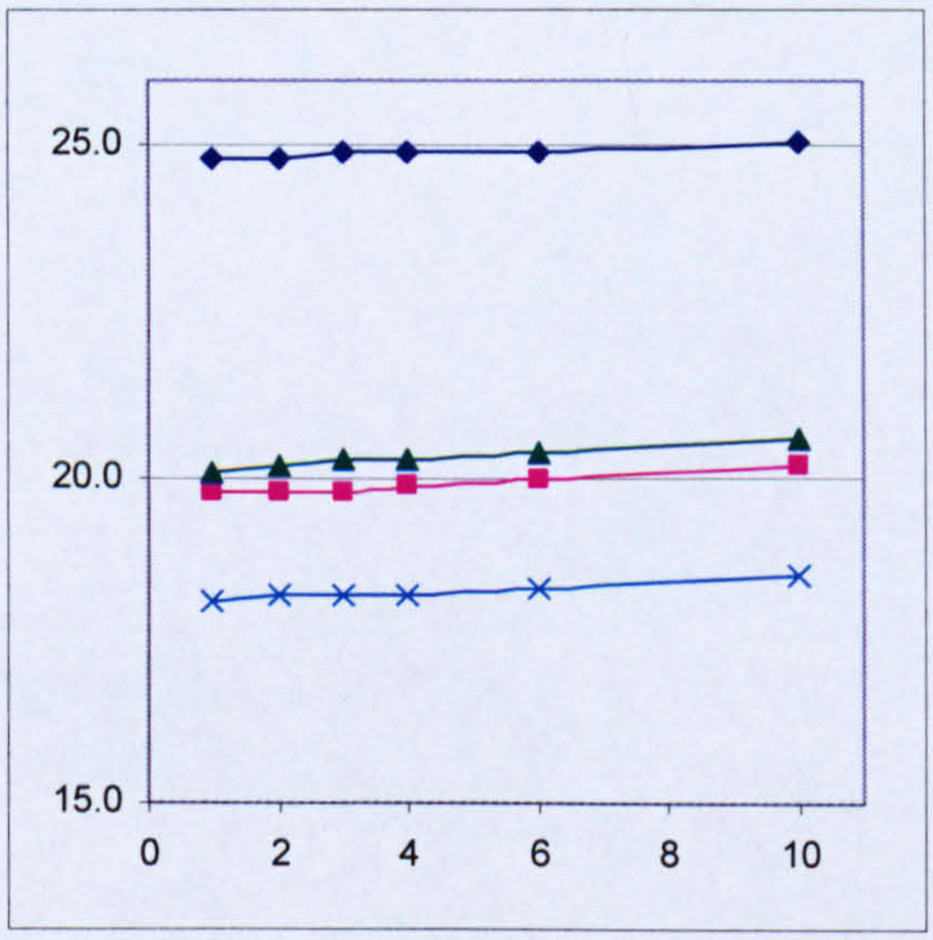
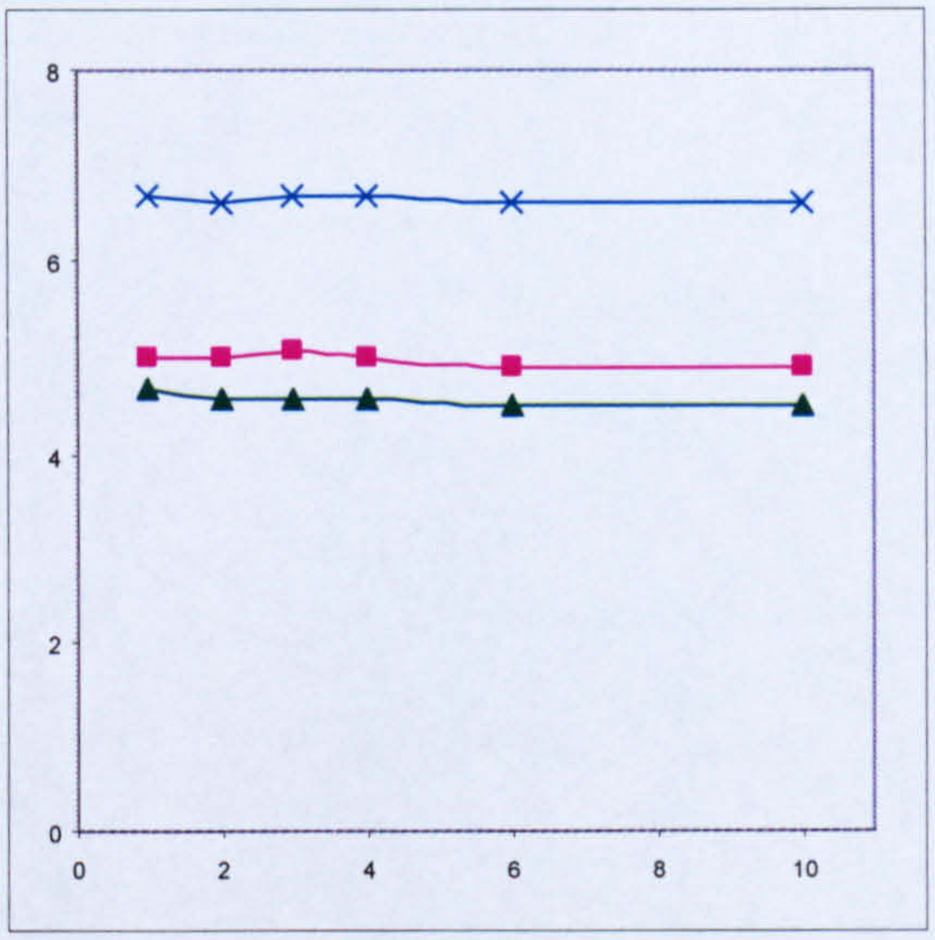


Figure 7:15: Difference of Gioia Tauro ACTT with other hubs v Mothership berthing (in hours)



ACTT. More over a minimal increase to these levels brings about significant reductions in the ACTT. However when handling operation is productive say (60 containers per hour) further improvements yield insignificant reductions on the ACTT.

As regards Figure 7:9 it can be observed that at 10 containers handling per hour the difference in ACTT between Gioia Tauro and Damietta is great (approximately 8 days). The reason being that local cargo volumes generated at Damietta are not loaded on to feeders. An

Table 7.14: ACTT for each hub subject to variations in the feeders' availability (hours)

	ACTT (days)			
Feeder Availability	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
6	23.3	17.3	18.8	19.0
12	23.4	17.4	18.9	19.1
24	23.7	17.6	19.1	19.3
48	24.2	17.8	19.4	19.8
72	24.8	18.2	19.9	20.2
96	25.3	18.5	20.2	20.6
120	25.9	18.8	20.6	21.0

Figure 7:16: ACTT v Feeder availability (in hours)

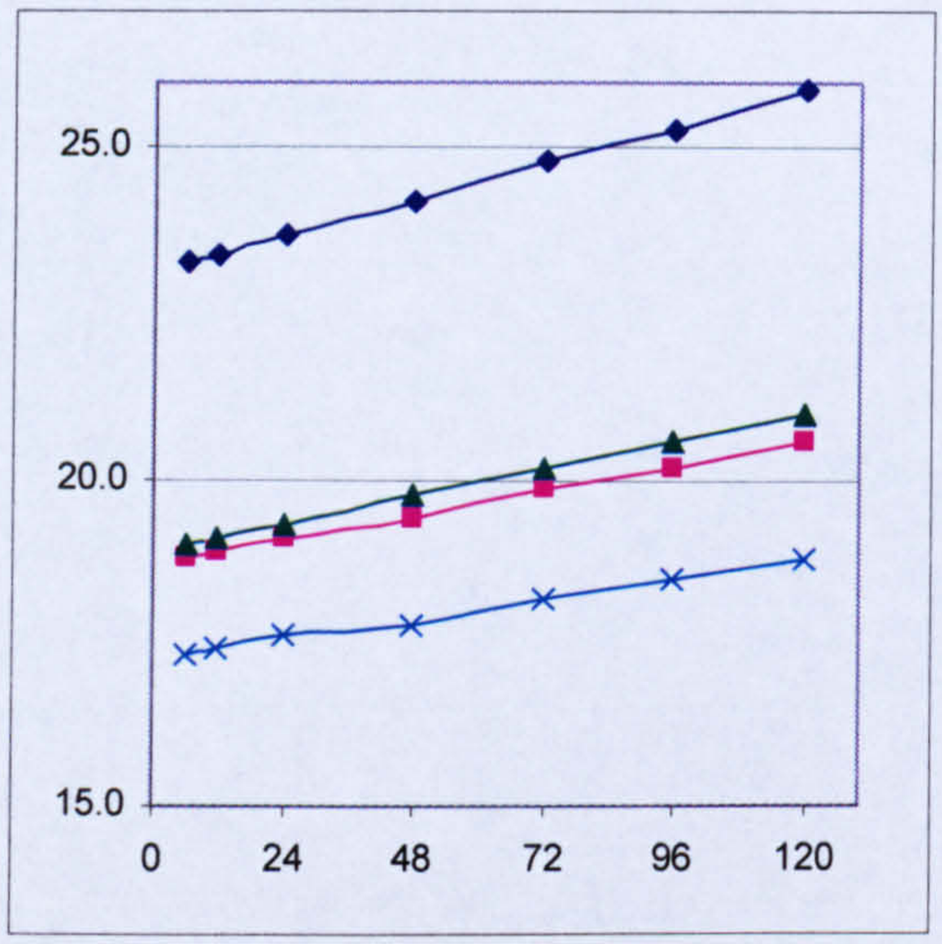
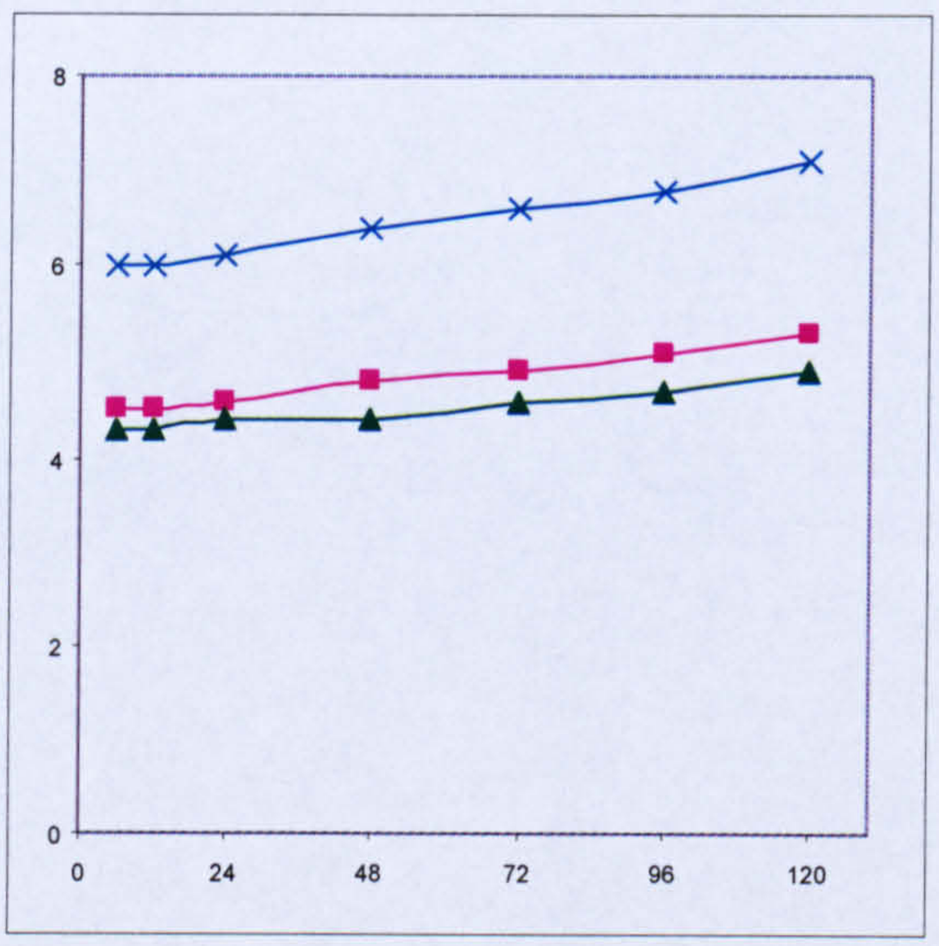


Figure 7:17: Difference of Gioia Tauro ACTT with other hubs v Feeder availability (in hours)



almost similar trend, Figure 7:11, is observed for the feeder unloading at the destination seaports.

From Figure 7:12 it appears that there is a similar trend with the speed of the Mothership. However when Gioia Tauro is the hub the ACTT becomes more sensitive at lower feedership speed as compared to the other Seaport hubs. The reason for this is the greater distance of Gioia Tauro to the seaports of destinations (geographic proximity to the market).

Table 7.15: ACTT for each hub subject to variations in the feeders' waiting time to berth (hours)

	ACTT (days)			
Feeders waiting time to berth	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
3	24.1	17.8	19.5	19.8
10	24.8	18.1	19.8	20.3
24	26.2	18.9	20.6	21.0
48	28.5	20.1	21.9	22.5
72	30.9	21.3	23.2	23.8

Figure 7:18: ACTT v Feeders waiting to berth
(in hours)

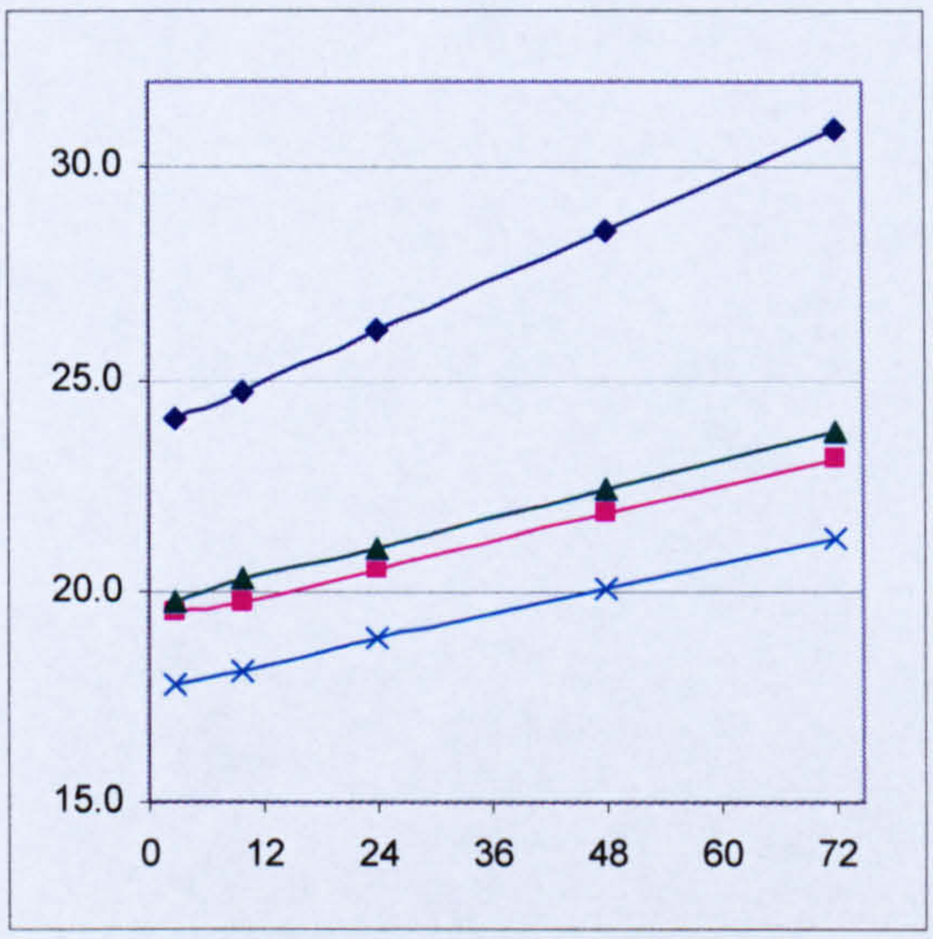
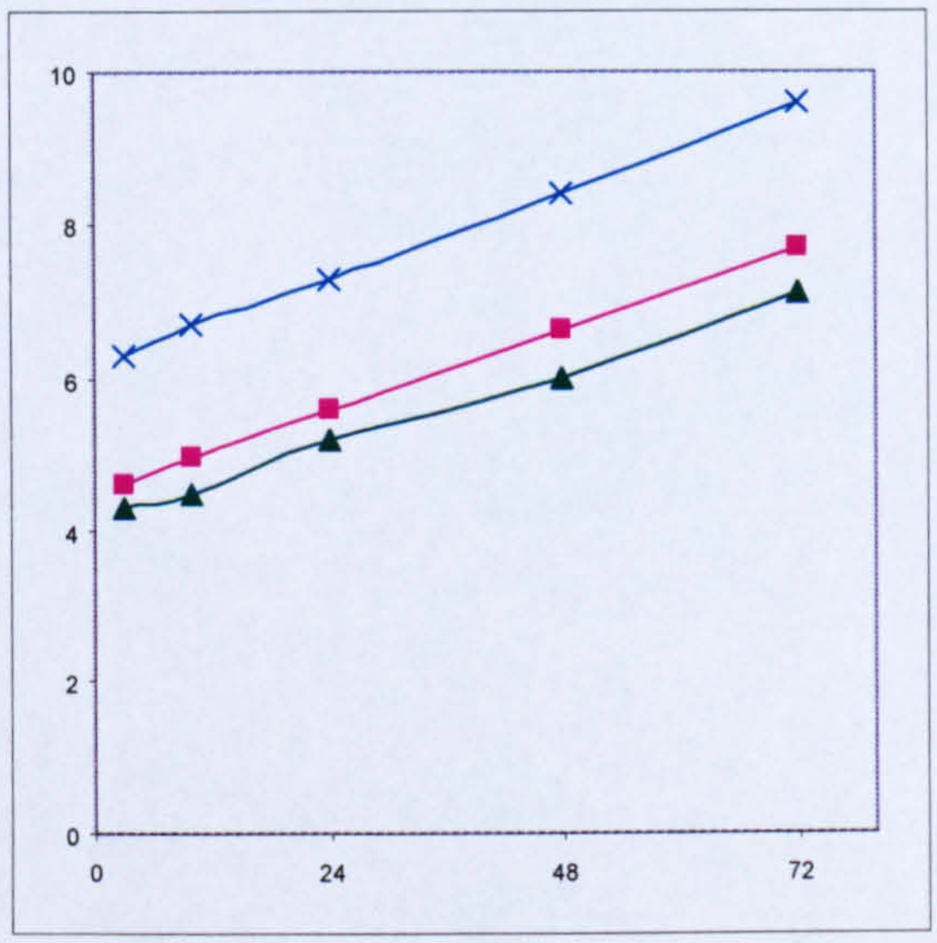


Figure 7:19: Difference of Gioia Tauro ACTT with other hubs v Feeders waiting to berth
(in hours)



Mothership berthing time generally kept at a minimum due to the importance of quick turnaround. Even though varying berthing time leads to insignificant changes in the ACTT, see Figure 7:14, it is essential for a hub to offer additionally quick berthing so as to facilitate faster turnaround for the motherships.

Table 7.16: ACTT for each hub subject to variations in the feeders' unforeseen delays (hours)

	ACTT(days)			
Feeders Unforeseen Delays	**G.Tauro**	**Damietta**	**Piraeus**	**Limassol**
0	23.7	17.5	19.1	19.3
24	24.2	17.9	19.5	19.8
48	24.7	18.2	19.8	20.2
72	25.3	18.4	20.2	20.7
96	25.8	18.7	20.5	21.1
120	26.4	19.1	20.9	21.6

Figure 7:20: ACTT v Feeders Unforeseen delays (in hours)

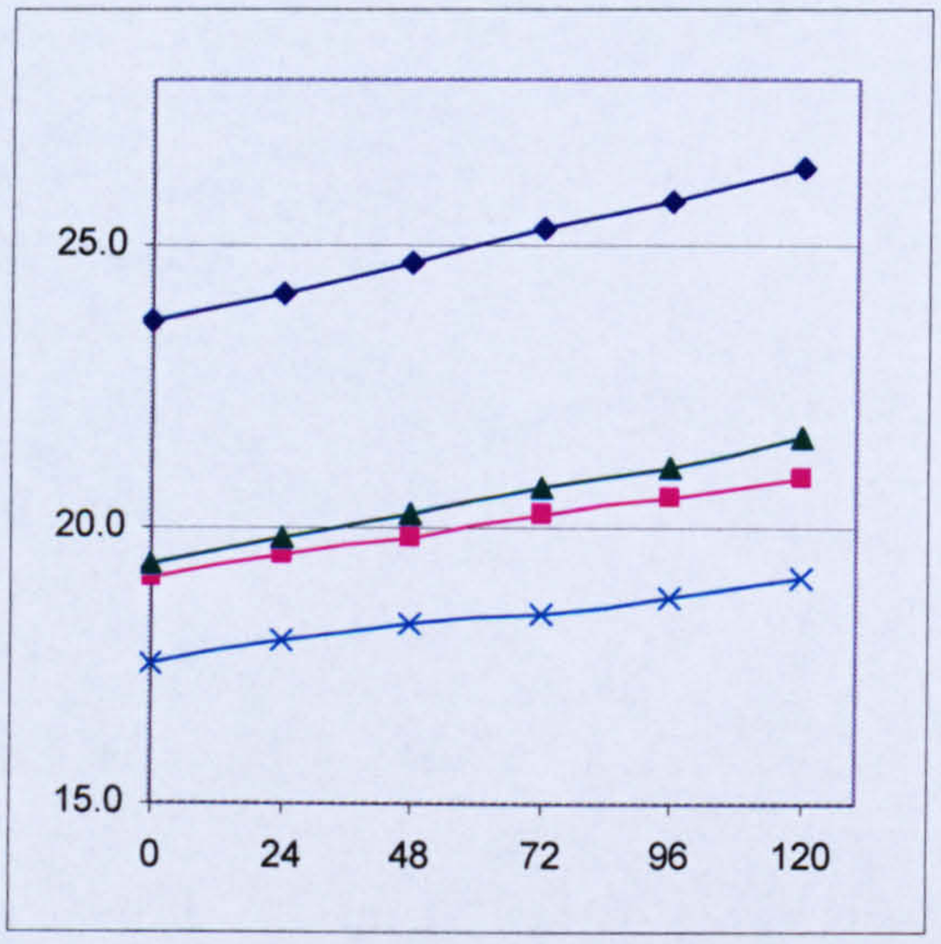
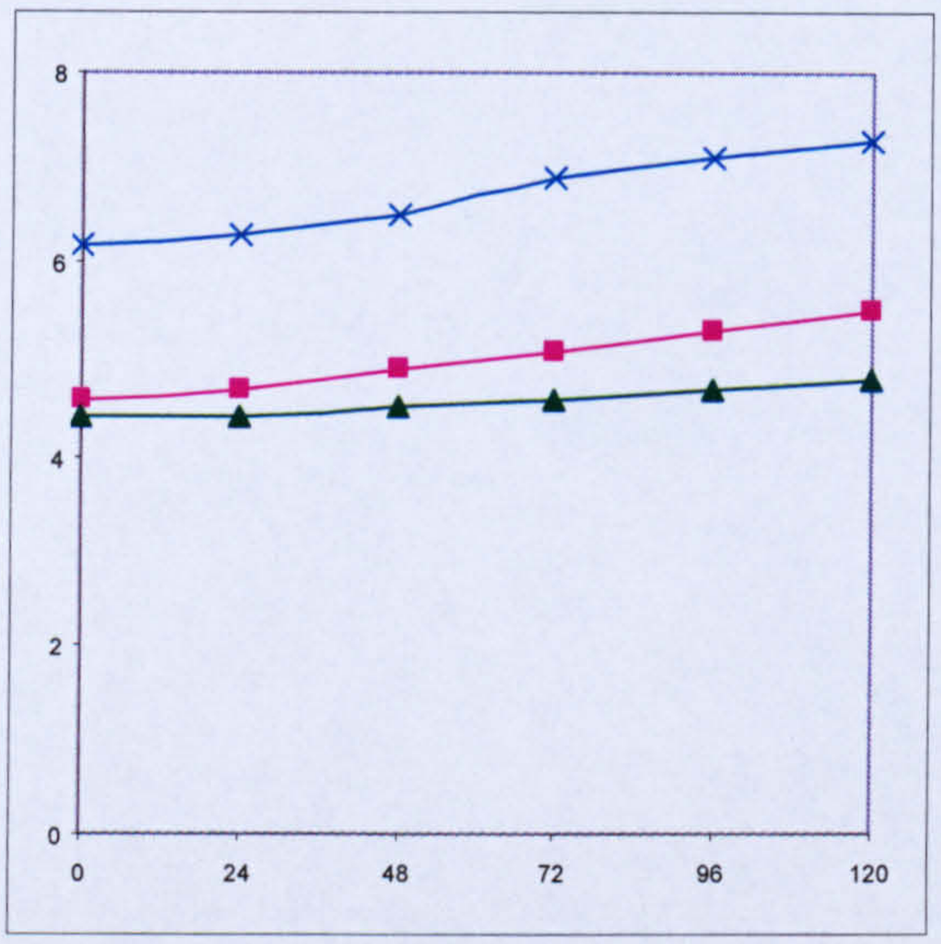


Figure 7:21: Difference of Gioia Tauro ACTT with other hubs v Feeders Unforeseen delays (in hours)



The positive linear dependence of ACTT on feeder availability depends mostly on the number of feeders utilized to serve the market.

Figure 7:16 reads that Gioia Tauro is more sensitive to feeder availability as compared to the other hubs. Precisely as feeder time availability increases, the ACTT difference of Gioia Tauro from other seaports increases linearly.

The ACTT is positively linear related to the time taken for feeders to berth, see Figure 7:18. Furthermore, the ACTT difference of Gioia Tauro from the other hubs increases linearly whereas feeder berthing time increases.

From Figure 7:20 it appears that ACTT has a positive linear relationship with feeder unforeseen delays. Furthermore, there is an indication that the ACTT difference of Gioia Tauro with Damietta and Piraeus hubs begins to increase slightly more for delays greater than 2 days, Figure 7:21.

7.5 Possible Scenarios for further reduction of transit time: The case of the Damietta seaport hub

The author takes the view that the scope of the current thesis should cover beyond the comparison of Central V Eastern Mediterranean seaport hubs transit time, also other possible scenarios of transit time.

To this extent the author considers a combination of improvement in the operations undertaken by Liner operators and the seaport of Damietta hub. Two such scenarios are investigated and applied to conditions, where the seaport of Damietta is chosen as a hub, and Liner operators perform to levels of operation as discussed below.

7.5.1 First Scenario

The parameter values employed in this scenario are similar to table 7.5 except: Mothership speed, Mothership rate of unloading, feeders availability and berthing at hub, feeders loading rate at hub, feeders speed, overall feeders unforeseen delays, see table 7.17

REALISTIC ADJUSTMENTS

Ships size

The vessel may be a 5000-6000 TEU capacity

Mothership speed

The speed is considered to be 25 knots which is regarded to be feasible operationally. Most of the large operators today employ such ships in the deep seas. Furthermore these ships have the capability to speed at this level.

Feeder Speed:

The speed of feeders at 18 knots is considered easily achievable. A 1300 TEU vessel may even further increase speed to this level and beyond 20 knots.

Feeders' unforeseen delays:

The element of unforeseen delays relates to the possibility where the Feeder Ship suffers certain delays. Proactiveness and reliability of dedicated Feeder ships may reduce this factor to 24 hour instead of 48 hours. Maersk Sealand operates feeders on fixed schedules with minimal deviation of the overall pre plan schedule.

Mothership rate of unloading

Again, this is considered to be a feasible factor, where the seaport of Damietta may deploy minimum 4 gantries to work simultaneously. It is a financial and policy decision to acquire the necessary quality and quantity of equipment. However all mega seaport hubs today operate the 6000 TEU vessels with 5-6 gantries, e.g. Hong Kong and new developments make plans for quays working on both sides of the mothership thus achieving double efficiency with even greater number of containers, Baird (2002).

Feeders' availability and berthing at hub:

Feeders are considered to complement motherships. A strategy to deploy feeders to call at the seaport hubs immediately upon departure of the mothership is again regarded to be feasible. Provided Liner operators employ their own feeders and have full control of their operation, the schedule can easily be maintained. Examples of this operation are Maersk Sealand where they combine both Mother and Feeder Ship in prearranged fixed schedule. However agreements need to be made between the Liner operators and the hub seaport in order to provide priority to the feeder upon motherships arrival.

The simulation was ran for 2500 iterations. From the results, see table 7.17, it appears that the ACTT maybe reduced to 14.2 days.

Table 7.17: simulation parameter values for the seaport of Damietta hub

Parameter values	**Mean**	**St.Dev**
Mothership Speed	25	1
Mothership berthing, ready for operations(excluding unloading)	2	0.5
Mothership rate of unloading	120	
Feeders availability and berthing at hub(excluding loading)	24	
Feeders loading rate at hub	60	
Feeders Speed	18	1
Feeders waiting to berth at each destin. seaport(excluding unloading)	10	2
Feeders unloading rate at destination seaports	30	
Overall feeders' unforeseen delays	24	
Mothership Cargo Volume	3000	250

7.5.2 Second Scenario: Changing the rate of the handling operations and the variability of cargo volumes at feedered seaports

Based on the previous (Section 7.5.1) scenario parameters, the author investigates the further scenario, whether different results may be produced through changing the following:

- The rate of handling (unloading) at the feedered seaports for each seaport under investigation based on current data, see Table 7.18. It is assumed that Pireaus, Haifa, Damietta and Limassol may sometimes utilize even 2 gantry cranes for their operations. These figures are based on empirical data rather than on official seaport records, which occasionally do not reveal the true picture. For example, the official Cyprus Seaports Authority guideline for gantry crane drivers at Limassol seaport, is in the range of 18 moves per hour. However, in practice this figure is much greater, reaching the range of 30 moves per hour. Furthermore, the seaports of Beirut, Mersin and Lattakia primarily do not have official data reflecting their handling productivily. The seaports of Damietta, Limassol, Haifa and Pireaus are considered to offer almost

similar rate of productivity. It is also noted that new technology (gantry cranes) will alter significantly seaport productivity in the future.

- The variability of the cargo volume destined at each feedered seaport. More precisely, seaport cargo is altered to vary with 1%, 5% and 7.5% standard deviation. It is noted that the author attempted greater values for the variation (e.g. 10%). However, due to the fact that certain seaports generate comparatively very small volume (e.g. Lattakia with 4%), a 10% standard deviation (under the normality assumption) causes random figures for seaport volume to go occasionally below zero. Evidently, simulation results cannot be obtained when such standard deviations are used. Following numerous trials with sequential values, it is pointed out that 7.5% standard deviation is approximately the maximum feasible value for the simulation under a normality assumption. The author acknowledges the fact that greater variations for seaport volumes may be more realistic, especially for Eastern Mediterranean Seaports. One reason being that greater variations can take into account market volatility in the Eastern Mediterranean countries. A possible way to overcome this limitation would be to employ an alternative probability distribution (instead of the Normal) for seaport volumes. One suggestion may be to employ the log-normal distribution which can generate non-negative random numbers. However, this has been considered by the author and not employed since this alternative distribution is not symmetric. For this reason the author employs the normal distribution and recommends that a more in-depth investigation is required for any other alternative choice of distribution.

Table 7.18: New simulation values for the unloading rate at feedered seaports
Source: Personal consultation with various Liner operators and shipping agents at the feedered ports

Feedcred seaports	Feeeder's Unloading Rate (containers/hour)
Piraeus	30
Izmir	20
Mersin	22
Latakia	20
Beirut	22
Haifa	30
Damietta	30
Limassol	30

The results are displayed in Table 7.19.

Table 7.19: Best ACTT for each hub with 1%, 5% and 7.5% standard deviation of the proportional seaport cargo volume

Hub	1%	5%	7.5%
Gioia Tauro	20.0 days	20.1 days	20.1 days
Piraeus	15.7 days	15.7 days	15.8 days
Limassol	15.7 days	15.7 days	15.8 days
Damietta	14.3 days	14.4 days	14.3 days

It appears that the results obtained through this more realistic scenario involving current data, reveals that the great reduction in ACTT is maintained as in the previous scenario. More specifically, Damietta offers a reduction of 28.5% (5.7 days) in ACTT, while Pireaus and Limassol offer a reduction of 21.% (4.3 days) compared to Gioia Tauro.

7.5.3 Recommendations

Both scenarios can be implemented through a sound collaboration amongst the participants of the supply chain, leading to an overall lead time reduction and enhance competitiveness. Possibly, the existing lead time disadvantage of Far Eastern products versus the European products may greatly be reduced. However, as previously stated the scope of this thesis does not cover the quantitative repercussions relating to costs/benefits of the transit time reduction

and overall impact in the supply chain. To this extent, the author considers this and previous findings as important tools for further future investigation, see for example Frankel (1999).

8. CONCLUSION

This thesis has been focused on the development and application of an appropriate research tool to investigate the feasibility or otherwise of establishing a regional seaport hub to serve liner operations in the Eastern Mediterranean in the 21st century.

With rising levels of worldwide container traffic the Mediterranean basin forms no exception to this growth. The need to service both through traffic volumes and local traffic has led to the emergence of seaport hubs, presently located in the Western, Central and Eastern parts of this large area.

Liner operators had been considering a new strategy during the mid 1990s, regarding cargoes originating from the Far East destined to the Eastern Mediterranean region; the choice being via a centrally located seaport hub instead of via Eastern Mediterranean seaport hubs. The author raised several questions in relation to this strategy since shippers experienced prolonged transit time delays. Feedback from Liner operators was minimal, so the author decided to evaluate the need for and choice of a seaport hub in the Eastern Mediterranean region based on the merits of international logistics supply chain with focus on lead time.

In Chapter 2, a review of the main developments in logistics was presented. The author emphasized the importance of international logistics and supply chains as part of a new trend, a new management system linking product material flow from source to user. This formed the basis of the thesis, since all participants in the value chain including Liner operators need to adjust to specific value chain prerequisites. Especially as worldwide markets become more volatile and service sensitive the element of Transport is considered crucial either forming a lean supply chain, a agile supply chain or a leagile supply chain.

Having reviewed the literature on logistics, in Chapter 2 it was shown that Supply Chain Management and Lead Time minimization are important trends of today. One aspect of greater integration, implied by Supply Chain Management is an increased emphasis on time compression. Time is in fact a "generalized cost" of production and distribution. It follows that Liner operators' choice of seaport hubs and overall transit time saving is regarded crucial to the supply chain competitiveness. Factors such as collaboration, customer service, shippers' criteria, time factor and lead time importance, as well as, the integration of transport are some of the areas where Liner operators adjust their service strategies. Evidently the shippers' choice of carrier is based on supply chain partnership, acquiring their assistance to increase market share, as well as, offering more value satisfaction to customers. As a result of this notion, the author concentrated mainly in the specific area of Transit Time and raised the following issues in relation to Liner operators' strategy to offer a service from the Far East to the Eastern Mediterranean region via centrally located hubs:

1) What are the alternative hub region options in the Mediterranean?

2) Which are the alternative candidate seaport hubs?

3) Which are the most important seaport hub criteria, considered by Liner operators and their respective ranking?
4) Which are the most suitable seaport hubs and their suitability ranking?
5) What is the transit time offered via seaport hubs in the Central and alternatively via Eastern Mediterranean seaport hubs?
6) Which seaport hub criteria, and to what extent, is transit time sensitive or robust (what if analysis).
7) To what extent can further reductions in transit time be achieved through the choice of a suitably located seaport hub?

In Chapter 3, the author reviewed the rapid developments that charectarise change in the liner trades in the last decade. Since the demand for shipping cargo is a derived demand, it needs to evolve as a part of the logistics supply chain process which involves shippers, operators and receivers. Ships have grown in size to the level of 8.400 TEU in order to achieve economies of scale, for example a 2.000 TEU ship has an average cost of 13 USD per TEU per day, where as a 6.000 TEUS ship has an average cost of 8 USD per TEU per day.

Further in Chapter 3 the developments of the liner trade and the emergence of liner operators were outlined. It was shown that, Liner operators establish strong coalitions amongst them and further aim for more control of their business through vertical integration, i.e. seaport terminals, and inland door to door logistics. Evidently Liner operators have transformed from product distributors to logistics providers offering a one-stop shopping. Within these integrated developments, the accelerated volume traffic increases and the global transhipment strategies, competition amongst seaports intensifies. More evidently, in the transhipment hub operations, world container transhipment throughput in 2001 represented 22% (54 million

TEUS) of world seaport demand and is further expanding. Apparently, it is noted that stevedoring costs may represent 25% of a shipping lines' main cost and to this extent seaport hubs become more popular when they generate, in addition to other factors, also large volumes of local cargoes. Aiming for success seaport hubs invest more towards becoming an integral part of a supply chain. Thus seaports do not provide only the geographical location of various activities but are considered a service center on their own. The Mediterranean seaports market is adjusted to these accelerated developments and progressively during 2003 generated 22 million TEU with a 10% yearly traffic increase.

Chapter 4 of the thesis presented the salient features of the seaports which were candidates for the role of a seaport hub serving the Eastern Mediterranean. A prominent characteristic of the Mediterranean is the considerable distances between its seaports. The distance from Algeciras (Gibraltar) in the West, to Beirut in the East, is over 2,000 N. miles. This has led the author to suggest the segmentation of the Mediterranean into three distinct peripheral seaport regions, namely the Eastern, Central and the Western. This is justified by the fact that most large container operators utilise two or even three Mediterranean hubs.

Eastern Mediterranean seaports' characteristics and facilities was the first step undertaken in order to describe the infrastructure and operational status. This was reinforced by a 10 day personal fieldtrip to several of these seaports. It appears that six seaports in the Eastern Mediterranean (handled almost the 100% of the transhipment volume during 1996), namely Damietta, Port Said, Alexandria, Piraeus, Limassol, Haifa (Larnaka seaport is included in the 1996 transhipment volume though since 1997 container activities of the seaport are almost non-existent). These seaports are in competition with Centrally located hubs namely Gioia

Tauro, Marsaxlokk, and Taranto, as regards containers originating from the Far East destined to the Eastern Mediterranean.

The author takes the view that the Eastern Mediterranean seaport market needs to be seen globally in terms of volume growth potential. The Eastern Mediterranean population now stands at approximately 150 million and is steadily increasing (not taking into account the Black Sea, which can be reliably served via an Eastern Mediterranean hub). In terms of cargo volumes (containers), a rough estimation for cargoes from and to the Far East - Eastern Mediterranean is 1.5 million TEU per annum[36]. Furthermore traffic from Asia grew by around 27% in 2003, where as volumes from Europe rose by approximately up about 10%. It appears that this growth of volumes originates from all regional countries of the Eastern Mediterranean and especially Egypt, Turkey and Greece. An indicative growth of the overall container throughput (from all over the world) in the Eastern Mediterranean between 1995-2001 revealed an increase of 63% (7,000,000 TEU in 2002). Furthermore, projections during 2001-2010, the expected seaport container handling demand is to increase between 59-79% for the whole Eastern Mediterranean, Ocean Shipping Consultants (2003). GDP growth during 2002 was 3.7% in Greece, 3.9% in Turkey, 2.5% in Cyprus, −1.5% in Israel, 2% in Egypt. These figures are indicative of typical growth potential for almost all countries in the region.

Interestingly the world container seaport demand between 1995-2001 increased by 69% to 244 million TEU and by 9.2% during 2002, the most rapid growth is witnessed in the East Asian market where, impressively, its total share of the world market increased from 37.6%

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[36] Personal consultation with Sarlis.

in 1990 to 43.5% and close to 46.4% in 2002. Most rapid expansion and growth, however, is centered on seaports in China. In the Chinese seaport region, a further growth of 88-99% is anticipated over 2001-2010, representing an increase of 84-89 million TEU. The author suggests that these developments in relation to expansion should not be neglected and most of the regions of the world, including the Eastern Mediterranean, may experience substantial traffic increases from the Far East.

A further point discussed in Chapter 4 was that centrally located hubs, namely Gioia Tauro and Marsaxlokk, faced periodic congestion problems during the years 2002-2003. However, since 2002 several liner operators changed their Far East – Eastern Mediterranean container service from centrally located seaport hubs to Eastern Mediterranean hubs (Damietta, Port Said and Piraeus). In addition, the biggest Liner operator Maersk Sealand within 2004 is said to start serving the Eastern Mediterranean via a new seaport hub terminal, namely the Suez Canal Container Terminal (SCCT) situated a few kilometres from Port Said.

In Chapter 5 the author demonstrated an important aim of the thesis namely, to determine the suitable seaport hubs in the Eastern Mediterranean. Given that the Liner operators are the primary decision makers in choosing seaports, the author conducted an investigation through a survey analysis. Six candidate Eastern Mediterranean seaport hubs, namely Damietta, Piraeus, Port Said, Alexandria, Limassol and Haifa, were chosen. Questionnaires were distributed to 7 major shipping lines that still nowadays offer a service from the Far East towards the Eastern Mediterranean, namely, Yang Ming, CMA, DSR Senator, Nedlloyd,

Contship, Evergreen and MISC[37], in order to determine the criteria used by them in selecting a seaport hub in the Eastern Mediterranean and to assess their relevant importance.

For the analysis of the questionnaire the author proposed various methods. The Average Scoring Method, as well as, the Gravity Scoring Method identified the suitability and most suitable seaport hub based on the ratings of certain criteria. It appears that 4 seaports are more suitable to act as hubs, namely, Piraeus, Limassol, Port Said and Damietta being the most suitable. The results of the Gravity Scoring Method, validate the results of the Average Scoring Method.

In Chapter 6, the findings of the survey revealed the strength and weaknesses of each seaport candidate, as well as, the top rated seaport hub. Overall, the weighted average ratings of seaports indicate that Damietta is considered to be the most suitable for the role of the seaport hub in the region. Damietta is followed closely by Piraeus, Limassol and Port Said. The remaining two seaports (Haifa and Alexandria) appear to be less suitable to act as hubs. However, this situation could change in the future as all seaports in the region strive to correct their weaknesses and improve their market position.

A further technique was used in the study, in order to rank the hub criteria. This made use of confidence intervals in order to determine whether there are significant differences between the averages of the criteria, and, hence, between their hierarchical ranking. The criteria are ranked according to the ratings they received from the shipping lines. The results suggest that local cargo and feedering connection are especially important criteria in the choice of a

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[37] Some of the named companies have changed status. e.g. Nedloyd is currently called P&O Nedlloyd. CMA is CMA CGM, senator is acquired by Hanjin though it operates as a separate entity.

seaport hub. This is because their high average rating is significantly different from that of several other criteria. Quick Turnround, geographic location and terminal space are also very important and are significantly different from a lower number of criteria. Furthermore, certain criteria do not posses significant differences.

Until now, the most potential seaport hubs in the Eastern Mediterranean were identified, namely Damietta, Piraeus, Limassol and Port Said. Furthermore, it has been argued that transit time is a crucial element in supply chain competitiveness.

Currently, (where centrally located seaports act as hubs) Far East containers destined to the Eastern Mediterranean cover almost an additional 2000 miles from Suez to Gioia Tauro and from Gioia Tauro to service several Eastern Mediterranean seaports. It is noted that the distance from Suez to centrally located seaports (Gioia Tauro) is approximately 950 Nautical miles. From there onwards, the feedership from Gioia Tauro needs to cover additional mileage to serve eastbound most of the Eastern Mediterranean seaports. Because of this, the author proposed the introduction of the criterion To-and-From, (Motherships transit time to the hub and feederships from the hub to the final destination) as a new tool to seek the geographic advantages of a seaport hub. It is obvious that transit time is highly depended on the distance covered. Since most of the cargo that is destined to the Eastern Mediterranean from the Far East is transhipped, the transit time may be reduced if an Eastern Mediterranean seaport hub is chosen instead.

In chapter 7, the author employs a simulation technique to quantify the element of transit time subject to specific alternative hub choices in the Mediterranean. In this respect the Eastern Mediterranean seaport hubs under investigation (Damietta, Piraeus and Limassol) are

compared with centrally located seaport hubs (Gioia Tauro, considered the biggest seaport in the Mediterranean). More precisely, the author focused on the cargo transit time taken from the Far East departure seaports (Kaohsung, Hong Kong and Singapore) until final seaport destination (Eastern Mediterranean). To achieve this, a simulation model was constructed. The model considered the cargo transportation procedure from departure seaports in the Far East until final seaport destination in the Eastern Mediterranean. The author proposed the use of the Average Cargo Transit Time, (ACTT) as a measure of comparison amongst Eastern versus centrally located hubs.

As a first step, the simulation describes the operational and geographical status currently prevailing, based on certain parametric variables, e.g. seaport hubs used, feeder seaports served, feeder schedules, speed of vessels, turnaround times, cargo volumes, distances, etc. In this way, the model may adapt to alternative seaport hub choices and obtain comparable transit times.

It appears that the Eastern Mediterranean seaport hubs, namely Damietta, Piraeus and Limassol offer significantly lower ACTT than Gioia Tauro situated at the central of the Mediterranean. More precisely, Damietta offers 6.5 days less ACTT, i.e. approximately 26.4% ACTT reduction, as compared to Gioia Tauro. On the other hand Piraeus offers 4.8 days less ACTT reflecting 19.5% decrease compared to Gioia Tauro whilst Limassol offers 4.5 less ACTT corresponding to approximately 18.3% decrease. Concerning Limassol and Piraeus appear to offer similar ACTT (Piraeus 19.8 and Limassol 20.1), the author believes that the reason for this is based mainly on the following: i) Piraeus generates substantially higher local volumes than Limassol, while ii) Piraeus geographic proximity to the market is less advantageous than the Limassol seaport hub. Damietta obviously offers a much lower

ACTT from both Limassol and Piraeus, because it generates high local volumes, as well as, possessing close geographic proximity to the market.

The simulation allows also the analysis of various scenarios in order to identify sensitive or robust features of the hubs under consideration. Each of the parameters has been separately examined for each hub, by altering its assumed value and determining its affect on the estimated value of the resulting ACTT.

Lastly two feasible scenarios are produced with the purpose to estimate further transit time reduction.The first feasible scenario considered parameter values, involving speed of vessels, loading and unloading rate, berthing times, feeder ships availability, unforeseen delays and total regional cargo volumes. In this time efficient scenario, seaport volumes being generated per seaport, varied with 1% standard deviation. In the second feasible scenario additional adjustments are incorporated. More specifically the rate of handling at the feedered seaports is adjusted to the productivity status of each individual seaport, instead of a fixed global rate employed in the first scenario. In addition the variability of cargo volumes being generated per each individual seaport, is increased at different levels. Numerous sequential values (from 0-10) were tried for the standard deviation. It appears that under the normal distribution of cargo volumes a maximum of approximately 7.5% standard deviation can be used. It was found that when the standard deviation is set at 10% in the simulation, was combined with the maintained assumption of the normal distribution, the output generated negative values for some seaport volumes, which is clearly not feasible. A possible suggestion to overcome this limitation would be to use an alternative probability distribution for seaport volumes. For example the log-normal distribution may be employed. However, this alternative is not symmetric. For this reason the author has chosen the normal distribution and recommends

that a more in-depth investigation is required for any other alternative choice of probability distribution.

It appears that the ACTT in these feasible scenarios, chosen by the author, may be reduced substantially. Such accomplishment can be achieved amongst the participants of the supply chain, leading to an overall further lead time reduction and enhance competitiveness. Possibly, the existing lead time disadvantage of Far Eastern products versus the European products may greatly be reduced. However, the scope of this thesis does not cover the quantitative repercussions relating to costs/benefits of the transit time reduction and overall impact in the supply chain. To this extent, the author considers all these findings as important tools for further future investigation, see for example Frankel (1999).

The financial implications of transit time reduction in the overall lead time needs to be investigated separately. For example, how do customers react to shorter delivery times or to what extent a lean supply chain or a agile supply chain is affected by a 27% transit time saving or 7 days. These effects must be quantified. In the example given by Wouters (1991) customers are willing to pay 3% higher prices for a reduction of lead time of 4 weeks.). According to Wouters (1991) possible effects are higher selling prices, higher selling volume, and earlier payments of customers.

A further future analysis may relate to the inventory reduction resulting from the transit time saving. Wouters (1991) points that lead time reduction may include fields like production, marketing, logistics or engineering. The author takes the view that case studies may need to be carried out to seek various costs/benefits on specific fields and commodities, on behalf of shippers, consignees, Liner operators, customers etc.

Concerning the "what if" analysis based on the simulation, further research is required to identify possible interactions of combinations between the variables of the simulation and to obtain new results in the ACTT based on such interactions.

Seaports in the Eastern Mediterranean region can attempt to stress the importance of transit time difference, amongst Eastern versus Central Mediterranean seaport hubs originating from the Far East. Thus the ACTT, as been discussed, can be considered as an important commercial tool on behalf of seaports to acquire business from Liner Operators. Similarly a Liner Operator that offers a service to the Eastern Mediterranean can plan, (based on these methodologies and estimations) the best ACTT and become a preferred carrier. More implications can arise from the results of this thesis especially to the advantage of Damietta, Port Said and the new Suez Canal Container Terminal operated by AP Moller Group. Progressively, the traffic from the Far East is increasing and Egypt is expected to continue to generate large volumes of local cargo. The present thesis provides a valuable tool for the seaport investors to acknowledge the importance and the success of their investment, especially as regards the new SCCT situated a few kilometers from Port Said. Piraeus and Haifa may expect similar growth potential in the future primarily based on their local cargo volumes. However, Haifa needs to overcome 2 major obstacles currently prevailing, namely the strong Unions and the political situation. Piraeus already acquired a sound status and new development plans will further boost this growth in the future.

Limassol, currently been underutilized may possibly expect some positive reactions taking place on behalf of Liner Operators due to the EU accession (1/5/2004) and the expected Turkish embargo to be up lifted. However the future may not be as good as the

aforementioned seaport hubs since local cargo volumes is considered a major deterministic factor, and Cyprus can not generate the volumes to the extend of its neighbouring competitors.

Towards this notion the present thesis provides some further tools where seaport hubs in the Eastern Mediterranean may consider. Seaports can benefit from these results by taking investment decisions – based on those areas that weaknesses/strengths may accrue. Confidence intervals used in the survey analysis reveal the ranking of importance per hub criterion and whether significant differences exist amongst these criteria. Even though the criteria chosen are, more or less, similar worldwide the author takes the view that the extent of importance per criterion is a valuable constructive tool for future investments. For example, the Limassol heavy investment for expansion plans may create benefits and opportunities to a far lesser extent compared to its neighbouring seaport hubs that generate also large volumes of local cargo. Contrary, more gantry cranes to be invested and installed in Damietta may create substantial benefits and opportunities. This methodology can be used for future application in other regional seaports around the world. Furthermore, the average scoring method, as well as, the gravity scoring method as demonstrated in the thesis, offer an additional valuable tool for seaport comparison purposes. More explicitly, seaport investors/seaport authorities may obtain a more thorough comparison on the status of regional seaports being in competition. For example, the Damietta seaport, although found to be suitable to act as a hub, through this methodology it can obtain evidence of its relative ranking as a regional hub. This can be used for executing or planning more rational investments.

A further implication discussed in the thesis is that certain hub criteria may cause relatively more positive impact to the overall transit time, e.g. speed of the vessels. Though some other hub criteria discussed, e.g handling equipment leading to faster turnaround time, may have lesser effect on ACTT. The criteria of vessels turnaround time is considered to be extremely vital to Liner Operators. Evidently, the simulation model reveals the impressive time effects of handling equipment conveying substantial time reduction for the turnaround of the vessel though minimal impact on ACTT reduction is observed. It is the authors' view that seaport hubs in the Eastern Mediterranean should offer a minimum of 4 gantries on the new generation Vessels and possibly in the future 8 in total, 4 on each side of the Mothership. For this to happen, heavy investments are required.

A last point to be raised by the author is that several changes have taken place between 1996-2004, in relation to the scope of the thesis. Gioia Tauro did not even start its operations until 1996 and during 2003 it generated 3 million TEU thus becoming the biggest seaport hub in the whole Mediterranean. However the congestion problem occurred is not considered to be the main reason why Liner operators' hub choice has changed recently. From 2002 onwards the market bear witness of Liner Operators shifting back to Eastern Mediterranean seaport hubs. It is the authors view that this shift provides a validation of the present thesis results, i.e. that there is a need for Eastern Mediterranean hubs. It is the author's view that this originates primarily from the overall increasing market especially from the Far-East towards the Eastern Mediterranean and the less ACTT offered in comparison to centrally located hubs. A reinforcing point is that supply chain competitiveness dictates this shift especially in the today's era where market volatility and service sensitivity prevail.

It is noted that the present thesis carries certain limitations. Evidently Liner operators considered information as confidential except where certain Liner operators have responded to the specific questionnaire. Furthermore the author focused primarily on the substantial export cargo from the Far East towards the Eastern Mediterranean since there is a major imbalance of the traffic. The repositioning of empty equipment westbound from the Eastern Mediterranean towards the Far East is evident. It appears that this imbalance will continue and become even greater in the next following years since the Far East market is considered as the fastest growing market in the world. Apparently, Liner operators account for this imbalance and quote freights that cover the return of the empty leg. However, in this specific thesis the overall evaluation and results do not alter the importance of the choice of a hub at the Eastern Mediterranean based on the findings and the substantial traffic volumes inbound.

An apparent limitation of this survey is that data were collected from only 7 companies. However these 7 companies, as noted in chapter 4, handled the majority (85%) of all transhipment cargo movements at the time the survey was conducted. It is also noted that 2 companies (Maersk Sealand and MSC) did not respond. This means that the survey does not cover all major Liner operators in the Eastern Mediterranean, but nevertheless, the results can be taken as representative.

A further limitation in obtaining this data is the weakness of the author to identify whether the respondents were strongly familiar with the seaports of the Eastern Mediterranean. Even though the questionnaire was addressed to the Line managers either directly or through their local agents still it is expected that feedback received may have been based on subjective merits. Thus no measurable objectivity can be ascertained.

Furthermore it must also be acknowledged that the data represent a picture of a specific chronological instance. Evidently in the today's era rapid changes take place in shorter periods of time, affecting data to be used as a constructive tool in the medium and long term. Other limitations include the non-accessibility to Turkish and Israeli seaports, during the author's fieldtrip. Another limitation was the fact that no similar investigation was ever conducted covering the Far-East traffic towards the Eastern Mediterranean with emphasis on the choice of seaport hubs based on the merits of international logistics-supply chain.Towards this notion the author focuses on the Eastern Mediterranean hub port choice and does not evaluate the central and West Mediterranean vast markets. In fact these markets are not considered to be a limitation of analysis in the current thesis. The author takes the view that the choice of a seaport hub at the Eastern Mediterranean does not affect the status and potential of centrally or Western Mediterranean hubs. Due to the long distances within the Mediterranean and the substantial volumes of their regions, hubs situated at the central and Western Mediterranean justify their existence. Evidently, the alternative for Liner operators is not to serve the central and Western Mediterranean through Eastern Mediterranean hubs, as the practice implies. Indicatively certain Liner operators e.g. Hapag Lloyd has a service from the Far East that serves the Eastern Mediterranean through Damietta and offers a further service via Gioia Tauro that serves the Central Mediterranean.

A last point to be acknowledged by the author is that, previous studies focusing on the Mediterranean are examined solely from the Liner operators' point of you and to a great extend from the operational/cost element. However amongst other, the author in this thesis attempts to present a different approach, where, even though Liner operators appear to plan

the configuration of their ships schedule and services offered, it is the supply chain competitiveness indirectly that dictate such decision.

APPENDIX I: INTERVIEWS AND PERSONAL VISITS

Personal Visits on pre-agreed appointments: Damietta, Alexandria, El Dheikheila, Piraeus, Limassol, Larnaka, Beirut.

Personal interview with directors/managers of Damietta, Alexandria, El Dheikheila, Piraeus, Haifa, Limassol.

Field trip visiting seaports and agents 10 days.

Interviews and exchange of data with shipping agencies: Egypt, Israel, Greece, Syria, Turkey, Beirut.

Location	**Name of Agency**
Piraeus	Sarlis and Angelopoulos
Alexandria	Finmar Mouselhy and partners
Beirut	Seamen International
Port Said	Finmar Mouselhy and partners
Lattakia	Shipping Agencies (shipco)
Izmir	Ataturk CAP (through Sarlis Lines Piraeus)
Israel	M.L.S. Middle East Logistic Services and Mr. Mendi Zaltzman (Director of Haifa Seaport)

Shipping Lines	**Name of Agency**
Yang Ming	Sarlis and Angelopoulos Piraeus
CMA	Manda Navigation Limassol
DSR Senator	Yiorkatzis and Papathomas Limassol
Nedlloyd	Frankoudi and Stefanou Limassol
Contship	Seascope Limassol
Evergreen	Gulf Agency Limassol
MISC	GAP Vassilopoulos Nicosia www.gapgroup.com

APPENDIX II:THE QUESTIONNAIRE

I am conducting research in order to collect information on the main criteria used by shipping lines in the selection of a seaport hub in the Eastern Mediterranean. I would appreciate it if you could take some time to fill this questionnaire.

1. Name of Shipping Agent/Line:.....

2. Please indicate the extent to which the following criteria are important to the above shipping line in choosing a seaport hub in the Eastern Mediterranean. In doing this, use a scale of 1 to 10 where 1 stands for NOT AT ALL IMPORTANT and 10 for EXTREMELY IMPORTANT. If you believe that a criterion is of AVERAGE IMPORTANCE, rate it as 5.

CRITERIA	**RATE (1, 2, 3, 4, 5, 6, 7, 8, 9, 10)**
1. Geographic Location	
2. Proximity	
3. Terminal Space	
4. Land and sea access	
5. Low Cost	
6. Capable Labour	
7. Transhipment Capability	
8. Understanding Landlord	
9. Handling of Equipment	
10. Quick Turnaround	
11. Feedering Connection	
12. Labour Relations	
13. Political Issues	
14. Local volumes cargo	

3. Please rate the following 6 main Eastern Mediterranean seaports on the criteria previously mentioned. Again use a scale of 1 to 10, where 1 indicates that a specific seaport is NOT AT ALL SATISFACTORY on a certain criterion, and 10 indicates that it is EXTREMELY SATISFACTORY. For example, if you think that Limassol is extremely satisfactory in terms of geographic location for your shipping line, give it a grade of 10. If you think that it is not at all satisfactory for your shipping line, you will rate it as 1. If you think that the geographic

location of Limassol is AVERAGE, rate it as 5. The same should be done for all seaports on all criteria, using the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

CRITERIA	Limassol	Piraeus	Damietta	Alexandria	Port Said	Haifa
1. Geographic Location						
2. Proximity						
3. Terminal Space						
4. Land and Sea Access						
5. Low Cost						
6. Capable Labour						
7. Transhipment Capability						
8. Understanding Landlord						
9. Handling of Equipment						
10. Quick Turnaround						
11. Feedering Connection						
12. Labour Relations						
13. Political Issues						
14. Local volumes cargo						

THANK YOU FOR YOUR HELP

APPENDIX III: GIOIA TAURO SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: Pier East: 1 container quay, length 3,011m, depth 13.5-15m

Pier North: 1 ro-ro quay, length 144m, depth 12.5m

Direct-call liner services: CP Ships, Evergreen, Horizon, Maersk Sealand, Safmarine

Terminal facilities: Total area 1,300,000m2; storage 55,038TEU; reefer points 1,200 electric. Ship-shore container gantries (super post-Panamax) 4 Liebherr; Ship-shore container gantries (post-Panamax) 3 Metalna (72t), 3 OMG (72t), 8 Vulkan Kocks (56t); Mobile cranes 3 Gottwald (100t x 2.60); Straddle carriers 20.30 Sisu (40t); Front-end handlers/reachstackers 3 CVS (45t), 3 CVS (8t), 3 Kalmar (40t); Forklifts 12; Yard tractors 42; Yard chassis/trailers 16; Multi-trailer systems 6.

Computer Systems: Hardware: IBM AS400

Software: Cosmos

Functions: Yard and Vessel planning

Rail facilities: Six rail tracks, total length 4200m

Hours of working: Vessels: Mon-Sun 24 hours

Reference

Containerisation International Yearbook 2004

APPENDIX IV: MARSAXLOSKK SEAPORT: FACILITIES AND CHARACTERISTICS

Direct-call liner services: APL, CMA, CGM, CP Ships, CSCL, Hamburg Sud, HLCL, Maersk Sealand, Marfret, Navibulgar, Norasia, PON

Terminal Facilities: Reach stackers 5 Fantuzzi (45t), 3 Kalmar (40.5t x 2.16t); Forklifts 2 Kalmar (35t, 16t), 10 Lansing (25t x 2, 5t x 4, 2.5t x 4); Yard tractors 30 MOL, 31 Sisu, 21 Terberg; Yard Chassis (skeletal) 34 Buiscar (45ft x 20, 40ft x 14), 22 Malta Shipbuilding (40ft); Yard chassis/trailers 6 (40ft), 58 Sisu (40ft); Rolltrailers (gooseneck) 6 Buiscar (40ft), 2 MAFI (20ft); Multi-trailers systems 32 Gaussin ((train)), 5 MOL ((tractor)).

Terminal One

Berths: North Quay: 1 Container berth, length 1.000m, and depth 15.5m

West Quay: 1 general cargo berth, length 168m, depth 9.5m

Terminal Facilities: Total area 263.648m2; storage 5.806TEU; reefer points 272 electric. Ship shore container gantries (post-Panamax) 1 Paceco (30.5t); Yard gantries (rail-mounted) 2 MGM (40.5t); Yard gantries (rubber-tyred) 11 Ansaldo (40.5t), 1 Paceco (30.5t), 1 Reggiane (30.5).

Computer Systems: Hardware: Various software: in-house, Navis SPARCS and Express Functions: container tracking, yard and ship planning, container and equipment control, mobile vehicle and cargo system

Rail Facilities: None

Hours of working: Vessels: Mon-Sun 24 hours; except 5 non-working days

Terminal Two

Berths: ro-ro berth, length 220m, and depth 15.5m

North Quay: 1 container berth, length 480m, depth 15.5m

South Quay: 1 container berth, length 660m, depth 15.5m

West Quay: 1 container berth, length 118m, depth 15.5m

Terminal Facilities: Total area 210,998m2; storage 5.028TEU reefer points 384 electric. Ship shore container gantries (super post-Panamax) 8 MGM (40.5t); Yard gantries (rubber-tyred) 16 MGM (40.5t).

Computer Systems: Hardware: Various Software: in-house, Navis SPARCS and Express Functions: container tracking, yard and ship planning, container and equipment control, mobile vehicle and cargo system

Rail facilities: None

Hours of working: Vessels: Mon-Sun 24 hours; except 5 non-working days.

Berths: 1 container berth, length 600m, and depth 13m

1 ro-ro berth

Direct-call liner services: ACL, Admiral, ASSA, Borchard, Contaz Line, CTE, EMES, Empros, Evergreen, FAS, GNMTC, Grijmaldi, Hamburg Sud, Maersk Sealand, MCL, MSC, Navibulgar, Nordana, OOCL, PONL, SCS, Tarros, Turkish Cargo, Turkon, UFS, Zim

Terminal Facilities: Total area 902,000m2; storage 3,000TEU. Ship-shore container gantries 5 (40t); Mobile cranes 14 (5t-25t); Yard gantries (rubber-tyred) 19 (3t-25t); Reachstackers 20 (40t); Front-end handlers/reachstackers 23 (10t-42t); Forklifts 17 (1.5t); Yard tractors 36 (25t); Yard chassis/trailers 62.

Rail Facilities: Linked to TCDD rail network

Hours of working: Offices: Mon-Fri 0830-1730. Vessels: 24 hours. Gate: 24 hours.

Reference

Containerisation International Yearbook 2004

APPENDIX V: TARANTO SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: TCT: 4 container berths, length 1.500m, depth 14.3m

Direct-call liner Services: CCL, CMNI, EMES, Evergreen, Lloyd Triestino, MCL, MFI, SLS, Tarros, UFS

Terminal-facilities: Total area 950.000m2; storage 39.000TEU; reefer points 900 electric. Ship-shore container gantries (super post-Panamax) 8 Fantuzzi (16t); Yard tractors 43 Terberg; Yard chassis (skeletal) 45 Houcon (12m).

Computer systems: Hardware: SUN and IBM X-Server 220

Software: Top-X, Realtime Business Solutions, Evergreen Tie Commerce, EDI

Functions: ship, yard, gate and rail operations. Provides support for batch jobs, file server and EDI related functions

Rail facilities: TCT is linked directly to the Italian rail network with 5 tracks x 1.000m each

Hours of working: Offices: 0830-1730. Vessels: Mon-Sun 24 hours. Gate: Mon-Sun 24 hours. Gate: Mon-Fri 0700-1900; Sat 0700-1300.

Future plans: 2 ultra-post panamax ship-shore container cranes (22 rows outreach) will be delivered mid-2003 and other 2 by beginning of 2004.

Phase III of development is due to be completed in three years adding 350m of quay and 200,000m of yards and further supply of4 ship-shore container cranes and relevant yard gantries.

Reference

Containerisation International Yearbook 2004

APPENDIX VI: PIRAEUS SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 3 ro-ro berths, length 880m, debth 10-16.5m

Terminal Facilities: Ship-shore container gantries 1 Metka (40t)

Venizelos Container Terminal

Berths: 9 Container berths, length 3.100m, depth 11.5-16.5m

Terminal facilities: Total areas 900.000m²; storage 30.500 TEU; reefer points 288 electric. Ship-shore container gantries 14; Straddle carriers 65; Front-end handlers/reach stackers 37 (35t-8t); Yard tractors 24.

Container freight stations:

Other CFS providers:

CFS in port (operated of Port Of Piraeus Authority SA). Total area 600.000m²; Covered are 40.000m²; storage 30.500 TEU; reefer points 288 Electric.

CFS in port (operated by Piraeus Port Authority). Covered area 3.000m2.

Computer Systems: Hardware: MIS Function: terminal operation

Hours of working: Vessels: 24 Hours, Mon-Sun available on request.

Future Plans: Construction of Pier III (total length 2.000m, depth 16.5m and total area 400.000m2). The office building will also be extended to a new area of 1.000m2

Reference

Containerisation International Yearbook 2004

APPENDIX VII: LIMASSOL SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: East Quay: 1 container quay, length 480m, and depth 11m

North Quay: 1 multipurpose quay, length 430m, depth 11m. Ro-ro berthing

West Quay: 1 multipurpose quay, length 450m, depth 11-13m. Ro-ro berthing

West Quay: 1 ro-ro berth, length 50m, depth 14m

Direct-call liner services: Borchard, BSL, Gracechurch, Grimaldi, Inscont, MCL, MSC, Nordana, SCS, Zim

Terminal Facilities: reefer points 48 electric. Ship-shore container gantries 2 Reggiane (40t); Quay cranes 1 Stothert & Pitt (35t); Mobile cranes 1 Gottwald (36t).

West Side Container Terminal

Berths: Dolphins: 5 floating pontoons, length 1.075m, and depth 11m

North Container Quay: 1 container quay, length 300m, depth14m

West Container Quay: 1 container quay, length 320m, depth 14m

Direct-call liner services: Borchard, Gracechurch, Grimaldi, Hamburg Sud, Insont, Maersk Sealand, MSC, Navibulgar, Nordana, SCS, UASC, Zim

Terminal Facilities: Total area 342,500m2; storage 10,000TEU; reefer points 60 electric. Ship-shore container gantries (post-Panamax) 2 CT Ceretti Tanfani (45t); Ship-shore container gantries (Panamax) 2 CT Ceretti Tanfani (40t); Yard gantries (rubber-tyred) 2 Paceco (40t), 2 Valmet (40t); Straddle carriers 7 Valmet (40t); Top-lifters 7 Kalmar; Front-end handless/reach stackers 6 Hyster (48t x 2, 44 x 4); Forklifts 1 Lancer Boss (20t); Yard tractors 5 Capacity, 13 Sisu, 6 Terberg; Yard chassis/trailes 60.

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 10,800m2; Covered area 10,000m2; storage 800TEU; reefer points 56 electric. Forklifts (stuffing/stripping) 15 (to 3t).

Computer systems: Software: CyPOS Functions: port information system, all port operations

Hours of working: Offices: 0730-1430. Vessels: 07300-2400. 24 hours available on request. Gate: 0600-2230.

Future Plans: Expansion of West Terminal Container Quays. Acquisition of additional gantry cranes.

Reference

Containerisation International Yearbook 2004

APPENDIX VIII: DAMIETTA SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 2 ro-ro berths, length 60m, depth 12.5/14.5m

Berths 1-4:4 container berths, length 1,050m, depth 14.5m

Direct-call liner services: CMA, CGM, HLCL, Maersk Sealand, MISC, Norasia, NYK, PONL

Terminal facilities: Total area 575,000m2; storage 28,363TEU; reefer points 376 electric. Ship-shore container gantries 4 Gaillard (40t), 2 Kocks (40t), 4 Mitsubishi (40t); Quay cranes 3 Demag (20t), 2 P&H (16.5t), 1 PPM (45t); Mobile cranes 3 Gottwald (100t, 30t, 10t); Yard gantries (rubber-tyred) 10 Mitsubishi (40t); Front-end handlers/reachstackers 1 Kalmar (16t), 17Svetruck (45t), 2 Valmet (25t); Forklifts 6 Hyster (2.5t), 16 Mitsubishi Caterpillar (5t x 10, 3t x 6), 4 Valmet (15t); Yard tractors 45 (50t); Yard trailers (flatbed) 3 Samro (28ft); Yard chassis/trailers 40 (40ft).

Container freight stations: Provided by port/terminal operator: CFS in port: Covered area 4,400m2. Forklifts (stuffing/stripping) 6 (3t).

Computer systems: Hardware: HP LC3 with NT Server 4, 20 workstations running Windows 98. Software: Oracle, LAN

Functions: ship and yard planning, EDI

Rail facilities: Rail connections to Cairo and other parts of the Nile delta and Upper Egypt

Hours of working: Offices: 0800-1600. Vessels: 24 hours. Gate: 24 hours.

Future plans: New CTIS

Reference

Containerisation International Yearbook 2004

APPENDIX IX: ALEXANDRIA SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 3 container berths, length 720m, depth 14m

Direct-call liner services: MOL, Borchard, Coscon, Evergreen, Farrel, Hamburg Sud, Maersk Sealand, Norasia, Nordana, POL, SCS, TOL, Turkish Cargo, Turkon, Zim

Terminal facilities: Total area 163,000m2; storage 11,000TEU; reefer points 350 electric. Ship-shore container gantries 3 Liebbherr-Werk (40t, 32t x 2); Yard gantries (rubber-tyred) 4 Reggiane (40t x 2, 32t x 2); Front –end handlers/reachstackers 23 Syetruck (13t-16t x 12, 45t x 11); Yard tractors 22 MAFI (50t); Yard chassis/trailers 28 Ottawa (50t).

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 32,000m2; Covered area 28,000m2.

Computer systems: Available

Rail Facilities: Rail link to terminal

Hours of working: Offices: 8 hours. Vessels: 24 hours. Gate: 24 hours.

Future plans: New ship-shore gantry cranes and harbour mobile cranes and harbour mobile cranes

Reference

Containerisation International Yearbook 2004

APPENDIX X: PORT SAID SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 1 container berth, length 970m, depth 14.5-15m

1 ro-ro berth , length 300m, depth 11m

Terminal facilities: Total area435,000m2; storage 17,000TEU; reefer points 400 electric. Ship-shore container gantries (super post-Panamax) 1 Noell (41t); Ship-shore container gantries (post-Panamax) 2 Caillard (41t), 3 Liebherr (41t), 2 Liebherr (40t); Mobile cranes 2 Gottwald (100t); Yard gantries (rubber-tyred) 2 Mitsubishi (40t), 2 Noell (35t), 2 Reggiane (32t); Reachstackers 1 CVS (45t), 8 Fantuzzi (45t), 3 Fantuzzi (7.5t), 3 Sisu (40t); Front-end handlers/reachstackers 2 Caterpillar (12t), 1 CVS (13.6t), 1 Kalmar (12t), 1 Valmet (28t); Yard tractors 33 CVS (60t), 4 MAFI (60t), 12 PlanMarine (60t).

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 145,000m2; Covered area 6,750m2; storage 300TEU; reefer points 400 electric.

CFS Hours of working: Offices: 24 hours. Yard: 24 hours.

Computer systems: Hardware: Client/Server Network, Oracle 9i/Win 2000 Server

Software: in-house

Functions: ship operation, yard, gates and accounting, RDT for terminal operations, EDI

Rail facilities: One rail terminal

Hours of working: Offices: 24 hours. Vessels: Mon-Sun 24 hours. Gate: 24 hours.

Reference

Containerisation International Yearbook 2004

APPENDIX XI: HAIFA SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 4 container berths, length 960m, depth 11.5-14m

Terminal facilities: Total area 40.000m2; storage 15.800TEU; reefer points 640 electric. Ship-shore container gantries (post-Panamax) 4 Kocks (40t); Ship-shore container gantries (Panamax) 4 Kocks (40t); Quay cranes 2 Kocks (35t); Yard gantries (rail-maountain) 3 DSD-Hilgers, 4 Konecranes (40t), 6 Vulkan Kocks (35t).

Computer Systems: Functions: Container tracking and billing system

Hours of working: Offices: 0730-1600. Vessels: 0630-1430, 1430-2200, and 2200-0530.
Gate: 24 hours

Future plans: Reclamation and extension of two RMG runs

Western & Kishon Terminals

Berths: 2 ro-ro berths, length 528m, depth 10m Kishon Terminal: 2 multipurpose berths, length 630m, depth 10m. Western terminal: 2 general cargo/container berths, length 400m, depth 8.5-10.5.

Terminal facilities: Total area 70.000m2; storage 1.000TEU; reefer points 200 electric. Ship-shore container gantries 2; Quay cranes 7 Boomse (15t, 25t x 4, 35t x 2), 2 Kocks (35t); Front-end handlers/reachstackers 3 (42t).

Computer systems: Functions: container tracking and billing system

Hours of working: Offices: 0730-1600. Vessels: 0630-1430, 1430-2200, 2200-0530.
Gate: 24 hours.

Future plans: East Kishon Quay, 580m long and 50m wide, will be operational during 2004

Reference

Containerisation International Yearbook 2004

APPENDIX XII: ASHDOD SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: Quay 7:1 quay, length 480m, depth 12m Quay 9: 1 multipurpose quay, length 435m, depth 12 m

Direct-call liner services: Borchard, Grimalti, Iscont, Maersk Sealand, MSC, PONL, Turkon, Zim

Terminal facilities: storage 13,700 TEU; reefer points 588 electric. Ship-shore container gantries 6 Vulkan Kocks (40t); Quay cranes (multipurpose gantries) 2; Yard gantries (rail-mounted) 10 (35t); Front-end handlers/ reachstackers 9 Caterpillar (42t) 10 Kalmar (25t x 3, 18t x 7); Yard tractors 56; Yard trailers (flatbet) 235.

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 20,000m2; storage 200TEU. Forklifts (stuffing/stripping) 10 Caterpillar (2.2t), 7 Hyster (2.2t)

Computer systems: On-line container management and billing

Hours of working: Vessels Sun- Thurs 0630-1430, 1500-2230, 2230-0500; Fri 0630-1300, 1300-1630, Sat 2230-0500. Gate: Sun-Thurs 24 hours, Friday until 1630.

Future plans: Hayovel terminal is due to be operatiional by end of 2004 and will included a a 600m quay and 50ha storage area

Reference

Containerisation International Yearbook 2004

APPENDIX XIII: IZMIR SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 1 container berth, length 600m, and depth 13m

1 ro-ro berth

Direct-call liner services: ACL, Admiral, ASSA, Borchard, Contaz Line, CTE, EMES, Empros, Evergreen, FAS, GNMTC, Grijmaldi, Hamburg Sud, Maersk Sealand, MCL, MSC, Navibulgar, Nordana, OOCL, PONL, SCS, Tarros, Turkish Cargo, Turkon, UFS, Zim

Terminal Facilities: Total area 902,000m2; storage 3,000TEU. Ship-shore container gantries 5 (40t); Mobile cranes 14 (5t-25t); Yard gantries (rubber-tyred) 19 (3t-25t); Reachstackers 20 (40t); Front-end handlers/reachstackers 23 (10t-42t); Forklifts 17 (1.5t); Yard tractors 36 (25t); Yard chassis/trailers 62.

Rail Facilities: Linked to TCDD rail network

Hours of working: Offices: Mon-Fri 0830-1730. Vessels: 24 hours. Gate: 24 hours.

Reference

Containerisation International Yearbook 2004

APPENDIX XIV: MERSIN SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: 10 general cargo quays, length 1,528m, and depth 6-10m

1 ro-ro ferry berth, depth 12m

2 container quays, length 710m, depth 10-12m

Direct-call liner services: Admiral, CMA CGM, Demline, FAS, Fast, Gracechurch, Hamburg Sud, Maersk Sealand, MCL, MEDEX, MSC, Navibulgar, Nordana, PONL, SCS, SLS, Subcargos, Turkish Cargo, UFS, Van Uden, Zim

Terminal Facilities: Total area 994,000m2. Ship-shore container gantries 3 MSM (40t); Mobile cranes 16 (5t-25t); Yard gantries (rubber-tyred) 18 MSM (40t); Reachstackers 8 (40t); Front-end handlers/reachstackers 4 Coventry Climax (2t), 17 Cukurova (3.5t), 3 Fantuzzi (12t), 7 Fenwick (5t) 5 Ismak(3.2t), 5 Komatsu (3t), 11 Lansing (40t x 2, 12t, 5t x 8); Forklifts 7 (10t-42t); Yard tractors 3 MAFI, 21 Sisu, 8 Terberg; Yard chassis/trailers 75.

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 16,000m2.

Rail Facilities: Linked to TCDD rail network

Hours of working: Offices: Mon-Fri 0830-1730. Vessels: 24 hours. Gate: 24 hours

Reference

Containerisation International Yearbook 2004

APPENDIX XV: BEIRUT SEAPORT: FACILITIES AND CHARACTERISTICS

Berths: general cargo berths, length 1,654m, depth 8-10.5m

Container berths, length 1,334m, depth 10.4-13m

Direct-call liner services: MOL, Adriatica, CMA, CGM, CP Ships, ECL, Fast, Gracechurch, Hamburg, Sud, Navibulgar, Niver Lines, Nordana, NYK, POL, SCS, Senator, Valfracht

Terminal facilities: Total area 1,200,000m2.

Mobile cranes 31 (300t-225t x 6, 165t-125t x 13, 25t x 12); Front-end handlers/ reachstackers 33;

Forkifts 16; Yard tractors 7; Yard chassis/trailers 78 (20ft/40ft).

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 29,750m2; Covered area 28,550m2; reefer points 250 electric. Forklifts 9 Allis-Chal (2.5t), 10 Allis-Chal (2.5t), 3 Allis-Chal (2.5t), 6 Clark Int (5t), 21 Clark Int (2.5t), 6 Clark Int (2.5t), 3 Komatsu (10t).

Hours of working: Vessels: 24 hours.

Container Terminal

Berths: Berth 16: container berths, length 600m, depth 15.5m

Terminal facilities: Total area 244,600m2; reefer points 440 electric. Ship-shore container gantries 3; Yard gantries (rubber-tyred) 6; Reachtrackers 6 (40t); Front-end handlers/ reachstackers 3 (12.5); Yard tractors 16 (12 terminal, 4 ro-ro); Rolltrailers (gooseneck) 4.

Hours of working: Vessels: 24 hours.

Reference

Containerisation International Yearbook 2004

APPENDIX XVI: LATTAKIA SEAPORT: FACILITIES AND CHARACTERISTICS

Berths 3 general cargo/container berths

Direct-call liner services: MOL, AWS, CP Ships, Hamburg Sud, Latvian, Nordana, POL, PONL, SCS, Senator, Syro-Jordanian, UDSC

Terminal facilities: Total area 120,000m2; storage 3,200 TEU. Quay cranes 12; Mobile cranes 6 P & H (60t); Straddle carries 4 Ferranti (32.5t); Front-end handlers/ reachstackers 2 Lansing Henley (32.5t); Forklifts (stuffing/ stripping) 63 Mitsubishi (3t-6t); Yard tractors 3 BT Bollnas; Yard chassis/trailers 10 PlanMarine (40ft).

Container freight stations: Provided by port/terminal operator: CFS in port: Total area 90,00m2. Forklifts (stuffing/stripping) 63Mitsubishi (3t-6t).

Computer systems: None

Rail facilities: Linked to the Baghdad/northern Syria main line.

Hours of working: Vessels: 16 hours. Overtime available on request

Reference

Containerisation International Yearbook 2004