8-27-2011

Optimum vessel size (new Maersk 18,000 TEU vessels) and operations in the Malacca Straits

Knoll David Brian

WORLD MARITIME UNIVERSITY

Shanghai, China

Optimum Vessel Size (New Maersk 18,000 TEU Vessels) and Operations in the Malacca Straits

By

Brian Knoll

United States of America

A research paper submitted to the World Maritime University in partial fulfillments

of the requirements for the award the degree of

MASTER OF SCIENCE

International Transport and Logistics

2011

Declaration

I certify that all the material in this research paper that is not my own work has been identified, and that no materials are included for which a degree has previously been conferred on me.

The contents of this research paper reflect my own personal views, and are not necessarily endorsed by the University

Brian Knoll

2011-06-12

Supervised by

Professor Xu Daxhen

World Maritime University

Acknowledgement

First and foremost I want to express my appreciation to Professor Ma Shuo and Ms. Zhou Yingchun who are in charge of the joint postgraduate programme at the Shanghai Maritime University. I would also like to thank Ms. Hu Fangfang who has been especially helpful and supportive throughout my time at the Shanghai Maritime University.

I would like to express my gratitude towards the Shanghai Maritime University and World Maritime University professors for passing along their passion and commitment to the field of logistics and transportation. I would especially like to thank both Prof. Patrick Donner and Prof. Mike Ircha for their constant communication and continuous support throughout the programme.

Finally, I would like to express my profound love and gratitude towards my parents, family and friends who have always shown their complete support though out my time in China. I truly appreciate the never-ending encouragement they have given me over the past two years.

Abstract

Title of Research Paper	**Optimum Vessel Size (New Maersk 18,000 TEU Vessels) and Operations in the Malacca Straits**
Degree	**M.Sc.**

This study was aimed at investigating the impacts of optimum vessel size of ship operations in the Malacca Straits. To this effect, the study narrowed down its emphasis on how the new Maersk 18,000 vessels will impact liner shipping in the Malacca Straits. In achieving this, the study utilized a qualitative methodology where a total of thirty participants were sampled. Basing on both the primary and secondary data collected, the study found out that the new Maersk 18,000 TEU vessels would have both positive and negative impacts on sea transport in the Malacca Straits route. As a matter of fact, majority of industry professionals believe these unprecedented vessels will enhance optimum ship operations at the Malacca Straits, will help reduce operations coats, will bring economies of scale, reduce the amount of fuel consumed, will reduce negative environmental impacts, and most importantly, will increase efficiency.

Keywords: Malacca Straits, Maersk, Optimum Vessel Size, Liner Shipping, Economies of Scale, Container Vessels, Shipping Operations

Table of Contents

List of Figures

List of Tables

List of Abbreviation

Malaccamax	Maximum draught that can pass through Malaysia and the Strait of Malacca
Panamax	Largest ship size that can be allowed in the Panama Canal
Suezmax	Largest ship size that can be allowed in Suez Canal
TEU	Twenty-foot Equivalent Units
US	United States of America

1.0 CHAPTER 1: INTRODUCTION

1.1 Background Information

Despite the enormous changes that have been registered in the realm of transport and communication, some of the oldest forms of transport continue to be used. A good example of this is the liner shipping industry. Liner shipping is one of the oldest transport forms yet it is one of the most used methods particularly in shipping heavy and bulky goods to destinations across oceans and around the world. Evidence shows that the growth in liner shipping has been steady with about 80 percent (about 60 million tons of cargo) of all world trade being conducted through sea by about 1.25 million seamen on about 93,000 vessels (Rosenberg, 2010). This phenomenal growth can be described as a response to a number of indicators such as changing customers needs, pressure from environmental enthusiasts to reduce greenhouse gas emissions, the highly volatile fuel prices, progressive regional and international legislations, and most importantly, to develop vibrant business models capable of mitigating the inevitable socio-economic shocks (Lorage, 2005).

Growth in liner shipping can be described using two major indicators: optimum ship size and optimum ship operations. Growth in liner shipping in terms of size is quite interesting. As a matter of fact, this growth is unprecedented in terms of both size and sheer volume. Following the invention of containers, liner shipping took a new dimension in terms of their numbers as well as the carrying capacity. The average sizes of container vessels have grown from 1306 TEU in the1980s to 2533 TEU in 2008. This trend is expected to continue courtesy of the increase in demand for liner shipping. The 18,000 TEU vessels ordered by Maersk Line, which is to be delivered by 2015, support this generalization. Some of the largest modern shipping vessels include the Ultra Large and Crude Carriers (ULCCs) and Very Large Crude Carriers (VLCCs). The ultra large crude carriers have a deadweight between 300,000 and 550,000 tonnes and are very important in the transportation of crude oil as well as other bulky raw materials such as coal between continents (Lloyd’s Register, 2011).

On the other hand and in terms of optimum ship operations a lot of advancements have been made. Over the years, industry players have struggled to maximize profits while reducing the cost of operations.. According to Gwillian and Molenaar (1993) significant growth in the shipping industry started being noticed in growth started being visible in the 1960s when the container box was invented. Growth also peaked up through the 1970s and 1980s when operational agreements were set up to oversee the smooth and cooperative shipping of goods. Again, phenomenal growth was registered through the 1990s when leading players started entering into alliances as a way of reducing competition and increasing overall throughput. As a matter of fact, these alliances facilitated the building and deployment of big ships in risky but lucrative routes that were initially shunned by operators.

1.1.1 Malacca Straits Route

The Malacca Straits is one of the world’s busiest and lucrative seaways. Situated between the Indian and Pacific oceans, the narrow and relatively deep channel is the most preferred connection route between the two oceans. Most liner shippers using the Indian-Pacific route pass through the strait so as to reach the Pacific from the Indian side. The route therefore can be described as the most popular connection between most Asian countries and the rest of the world. For instance, it connects the four of the major Asian economic giants of South Korea, China, Japan, and India (Leifer, 1978).

The strait has an approximate length of about 805 kilometers with a narrow width that sometimes narrows to a low of 2.8 kilometers. It stretches from the Malay Peninsula, Malaysia to Sumatra in Indonesia. Some of the major cargo that passes the strait includes coffee from Indonesia, Chinese goods, as well as oil from the Middle East. Annually, more than 50, 000 vessels pass the strait carrying more than a quarter of the world's cargo to various destinations (Freeman, 2003). Even so, like many other Indian-Pacific routes, the strait is invested with pirates who over the years have continued to pose great dangers to seamen and goods in transit.

1.1.2 Maersk Line

Maersk Line is A.P. Moller – Maersk Group biggest operating unit in terms of annual revenue. The unit's core business activity comprises of liner-shipping services to all destinations of the world. Being an A.P. Moller – Maersk Group unit, Maersk Line is based in Copenhagen, Denmark but has outlets all around the globe in more than 135 countries. Maersk Line operates about 550 vessels capable of hauling over 2.2 million TEU at any given voyage. This makes the company the largest in terms of the overall TEU hauled annually (Maersk, 2011).

The company boasts having the largest fleet of owned-vessels including the Emma Maersk (E-class), which the largest vessel which was delivered in 2006. Maersk has since acquired seven other similar vessels (E-class). To add on this, the company placed an order for ten 18,000 TEU vessels in 2011 which will be the largest liner shipping vessels (Triple-E class) when they will be delivered sometime in 2014. Together with other small-sized vessels, the Tripe E class vessels summed up to total of 857000 TEU for the company's order book for vessels in February 2010 (Maersk, 2011).

1.2 Research Statement

A number of studies have been carried out in response to the growth witnessed in the liner shipping industry. Some of these studies address the issue of optimum ship size on optimum ship operations. For instance, when tackling the link between ship size and optimum ship operations. Sys et al (2008) finds that there is a strong link between ship size and operations; optimum ship size is depended on a number of factors which may include the specific liner shipping segment (deep sea and/or short sea shipping), the shipping route, as well as the level of technological know-how; and optimum ship size in one route can be sub-optimum in another route and/or shipping segment.

Even so, Sys et al as well as a host of other studies are general in nature, as they do not tackle any specific ship size or a specific shipping route. Though it can be argued that the findings of these studies can be reasonably applied to specific ships sizes and/or shipping routes it is only wise to assert that there is a great need for studying how specific ship size impacts operations at specific shipping routes. To this effect, there is a great need to study how the new Maersk 18,000 TEU vessels which are slated to be delivered in 2015 will impact liner shipping in a major shipping route such as the Malacca Straits given that these are the biggest shipping vessels in the history of liner shipping.

1.3 Research Aims, Objectives, and Questions

This study was carried out with the main aim of establishing the impact of optimum ship size (the new Maersk 18,000 TEU vessels) on optimum ship operations in the Malacca Straits route. From this overarching aim, four objectives were drawn out to find out if new Maersk 18,000 TEU vessels will:

a. Enhance optimum ship operations at the Malacca Straits route
b. Help cut down operational costs at the Malacca Straits route.
c. Enhance efficiency at the Malacca Straits route.
d. Help reduce the amount of greenhouse gases emitted in the Malacca Straits route.

Again from these four core objectives six research questions were drawn out as shown below.

a. Will the new Maersk 18,000 TEU vessels reduce operational costs at the Malacca Straits route?
b. Will the new Maersk 18,000 TEU vessels reduce capital costs at the Malacca Straits route?
c. Will the new Maersk 18,000 TEU vessels enhance the value for money to shipping industry stakeholders?
d. Will the new Maersk 18,000 TEU vessels help reduce emission of greenhouse gases in the Malacca Straits?
e. Will the new Maersk 18,000 TEU vessels help shorten the length of time spent shipping goods from the port of origin to the port of arrival?
f. Will the new Maersk 18,000 TEU vessels help reduce the amount of fuel consumed by shipping vessels at the Malacca Straits route?

2.0 CHAPTER 2: LITERATURE REVIEW

2.1 Introduction and Structure of the Chapter

Researchers have dedicated significant space in analyzing the impact of ship size and ships operations. So as to create a platform for supporting the set research questions as well as interpreting the study finding, this chapter will attempt to review some of these existing relevant literary materials. To this effect, literary materials touching on the impacts of optimum ship size on ship operations will be covered. For purposes of clarity and coherence, the chapter is divided into seven core sections. The structuring of the sections was based on the overarching study aim as well as the set research questions. So as to provide a deeper insight in the topic some of the sections have got subsections.

2.2 Evolution of Container Ships

Since inception, the shipping industry has experienced a lot of changes. According to Gwillian and Molenaar (1993) these changes can easily be noted in key industry operations such as methods of handling cargo, shipping routes and trade patterns. Majority of the changes started being visible in 1960s when the container box was introduced through the 1970s and 1980s when consortia operational agreements were set up and in 1990s when global alliances started to be formed. In addition, the series of alliances that were formed in 1990s have enabled the industry to have the financial base required to deploy ships that are bigger in size and as result promoting economies of scale.

Again, the series of consolidations that have been experienced in the maritime industry have redesigned the industry with the first consolidation-taking place in 1995 and the second being experienced around 2005. According to assessment on the cellular fleet of the world as at

2008, there were approximately 4312 vessels with a total capacity of about eleven million TEUs (Lloyd's Register, 2011). Using the 2008 assessments, and assuming that the ordered vessels were delivered as contracted and with minimum scrapping period then the capacity is projected to grow by 15.18 percent during 2009, 14 percent during the year 2010, 13.71 percent in year 2011 and 8.59 % in year 2012. On the evolution of the containers, the number of sea vessels have grown at rate factor of five and the carrying capacity which is measured in terms of TEU has increased at a rate twice that of growth rate. The average size has moved from 1306 TEUs in the 1980s to about 2533 TEUs in 2008. Following increase in demand for sea transport over the years, this trend (increase in average ship size) is expected to continue up to a tentative optimum size of 3300 TEUs in the coming ten years (Lloyd's Register, 2011).

According to Foster et al (1999) the original ships could only carry containers with length of about thirty-five feet. The container ships were loaded into the ships using cranes. The capacity of these container ships was about 200 TEU. However, between 1960s and 1970s the capacity of the container ships grew starting in America and spreading to the European region and then to the Far East region. Consequently, towards the end of this period the container ships size had increased to between 2000 and 2500 TEU. The size gradually increased upwards with the next ten and fifteen years as the quantity of cargo that was being transported in the late 1980s continued to rise. During this period, the size crossed the 4000 TEU barrier. Once that point was reached the next phase-involved development of mega-container ships to enhance economies of scale. The United States in mid-1980s built the 4354-TEU capacity ships, which was classified under the mega- container ships category. Over the years, the ship sizes have continued to increase taking the usage of the term "mega-container ships" to another level. In modern times, mega-container ships are considered as those that exceed the capacity of 6000 TEU and the definition of mega-container ships changes with the generations in the evolution of ship sizes.

2.2.1 Modern Container ships

Modern container ships are classified in terms of their size as well as the nature of routes they operate. Ideally, every sea route has got the maximum size of ships that can pass through it. Some routes such as the Malacca Strait are very deep and therefore they can accommodate large ships carrying heavy cargo. Other routes such as the Suez Canal are very narrow and moderately deep and therefore have limitations on the size and/or deadweight of ships that can pass through it. According to Ham (2004) the assessment of routes to establish the maximum size of ship they can accommodate was necessary as it enabled ship builders and operators to make necessary plans on the nature of ships to build and/or to operate on any given route.

Based on the depth of route a ship operates in the following ships types are common. The Malaccamax refers to the maximum draught that can pass through Malaysia and the Strait of Malacca. As the name suggests, Panamax refers to the largest ship size that can be allowed in the Panama Canal. The length of the Panamax ship is limited to two hundred and seventy five meters and the width is restricted to thirty-two meters. Its deadweight is between 65,000 and 80,000 tones. The Suez Canal van only handle tankers (Suezmax) of about eighty thousand tones of deadweight but proposals have been made to expand the canal to enable it accommodate bigger ships. Capsize ships have deadweight of between one hundred and one hundred and eighty thousand tones. They are built to be used in deep water and transport heavy raw materials from Brazil (Lloyd’s Register, 2011).

2.2.2 The Size of a Ship

According to Loyola University, Chicago (2011) the shipping industry is experiencing unprecedented structural growth in terms of the ship size and volume. The industry is trying to develop ships for competitive advantage purposes. This salient goal will be achieved, as the sheer size will enhance economies of scale in terms of technology given that the maximal ships carrying capacity stands at 18,000 TEU. Drawing from the existing studies it is understandable that it is possible to deploy large container ships since there are no market obstacles or technical limitations, which might hinder the introduction of these vessels.

The factors influencing the size of the vessels can be traced by looking into the growth of the vessels over the years. According to Loyola University, Chicago (2011) there is several reasons why there is a need to understand the various factors that determine the size of the ship container. First there is huge capital invested in the process of operations, development and insurance of the vessels. Since there are changes being experienced in the sizes of the ships there is need for the investors to get informed on the factors determining the size of the ship since wrong investment decisions may lead to heavy losses experienced and proper understanding of the mechanisms that operate here reduces the risk.

Ham (2004) states that the size of the ship is determined by terminal facilities and obstacles found along the journey of the ship. What this means is that the size of the vessel can also be influenced by the draught restriction in the ports, the length and width of the water pathway, and restriction of the river port navigation. There are ports with draught limitations occasioned by shallow waters and hence they can allow some vessels only to some depth. As a result, the trading flexibility of large ships is limited in such shallow ports as they lack the facilities to handle them.

Sys et al (2008) support this argument by opining that the ships that have large draughts are limited especially by the physical restriction of the port. This sometimes requires cargo to be divided into small proportions from the theory on optimal size of the ship and as a result there are various optimal sizes that arrive at the destination. The optimal size of the ship can be as large as the owner wants. On the case of the demand, the size is determined by the amount and the frequency and the time the amount is moved from one port to the other. Large amounts to be moved requires larger ship that is cost effective in terms of the cost per TEU compared to the smaller ship. On the other hand and in regard to the frequency of the load being moved, it is arguable that the higher the frequency the smaller the vessel.

The market for container shipping is growing at a higher rate and this trend is expected to continue. Sys et al (2008) states that for the last four decades there has evolution in the container ships from feeders, then Panamax and to the present Post-Panamax ships. Even so, the Panamax ships still have the highest numbers among the world's largest ships. The other factor that limits the size of ship is related to the volume of the trade, which may change from one route to multiple routes. Due to the introduction of the transshipment that includes the spoke and the hub system the optimum size that will arrive at the destination is reduced. This means that there is an observable reduction in size.

2.3 Relationship between Economies of Scale and the Size of the Ship

Economies of scale exist in the shipping industry particularly when the bulk cargo is carried over a longer distance (Sys et al, 2008). In a given route economies of scale can be achieved when there is more freight cargo to be transported and the distance to be covered is high. However the factors of economies of scale cannot alone adequately explain the change in ship patterns. Over the recent times larger ships are affected heavily by the by longer turnaround time especially in short term and this difficulty is overcome by faster ships in the long run. In the past the cost per ton has previous affected the larger ships but today they are favoring the larger vessels.

Sys et al (2008) highlight economies of scale refers to property where there is mass production of goods and services with less cost of input. This means that economies of scale are to be achieved when if more units are produced in large scale with no much increase in the cost of production. The sharing of the fixed costs by the products produced and as result average cost decreases and this result to efficient cost of production. In the shipping industry this is achieved as result of having the cost per TEU decreasing as the size of the ship increases (Cullinane & Khanna, 2000). The cost is related to the cost of building the ship, manning and fuel costs. The proposition of a larger ship is lower compared to that of a smaller ship.

In the shipping industry, economies of scale can be achieved in two ways: in the ship and port operations. The shipping industry emphasizes on the benefits and speed the ship's turnaround time which will lead to fewer port calls, encourage on services of the feeder which involves the spoke and the hub concept. This makes the ship owners to benefit from economies of scale and be in a position to operate economically sized ship (Cullinane & Khanna, 1999).

To minimize the cost at the sea and at the port the optimal size of the ship be established first and this size of the ship is identified as the ship that can carry a given composition of the cargo at the lowest cost per ton of the cargo. To minimize the cost therefore the optimal size of the ship should be determined. As the size of the ship increases the cost per ton at the sea decreases but that the costs at the port increases. To determine the total cost per ton then the cost at the sea and the port are summed (Sys et al, 2008).

The costs of the ship consist of the running and the capital costs (Imai et al, 2006). Capital costs consist of the principal and the interest payments made in order to finance the building of the ship. The capital cost also includes return on capital, which is the opportunity cost that includes the interest lost as a result of tying the capital in the ship built. Lim (1998) notes that running costs can be identified in two parts the fixed and the variable costs which include the operational and the overhead cost The operational costs related to the ship include banking costs, marketing, advertising, management and accounting fees and the agency fees. The operational cost are those that are incurred in enabling the ship to operate and are not are independent in relation to the output and these are costs related to the maintenance and repair, victualing, stores, insurance and the crews (Imai, 2006). In the short, they are considered fixed. Running costs are those that can be avoided if the journey is not taken and includes the costs related to the fuel which is determined by the cost of the fuel, service speed, fuel grade and the distance covered by the ship. Long distances bring more costs compared to short distances.

2.3.1 Optimal Ship Size Concept

In theory of microeconomics the size of the firm determines its efficiency, that is, large firms minimize the long-run costs experienced by the firm. The size of a company is also determined by the market in which it chooses to operate. If the market is not sufficient, production and efficiency cannot be achieved even though the company might be having the technology to enable it take advantage of the economies of scale. The optimal size of the firm is determined by the economies of scale. However organizational factors may create diseconomies of scale and hence change the size of the firm. This means that the size of the firm is determined by economies and diseconomies of scale. The optimization of the liner service is determined by the type and the capacity of the ship and is viewed as an analytical tool as well as design variable tool (Sys et al, 2008).

Sys et al (2008) highlight that During the 1970s the focus was to use the maximum ship volume that could be accommodated at the port of origin and at the destination. With the rapid changes taking place in the industry, it is clear that there are other determinants of the size of the ship such as sailing frequency, the length of the route, port calls and the volume of trade. Optimal size of the ship is the size where the transport costs are reduced. The transport costs are considered in totality and the total transports cost include those incurred while the ship is at the sea and also in both the beginning and the end of the journey (Sys et al, 2008). The optimal size can be obtained by establishing the tradeoff between the economies brought by the size and the diseconomies brought by the other organizational factors as well as effects they have on the hauling and handling operations. The optimal size when viewed from the perspective of maximizing the profit is obtained by minimizing the cost per TEU.

2.3.2 Advantages and Disadvantages of Large Ship Sizes

To start with advantages of large ships, the growth in demand for sea transport has been phenomenal in the development of bigger ships. Technical advancements have also been noted in the shipping industry where the owners of the ships have started using larger ships in order to minimize the cost of transporting the various cargos in the sea (Talley, 2009). They have also developed optimal ships that will bring a tradeoff between the economies of scale derived from hauling operations at the sea and the diseconomies of scale derived from the handling operations at the port. This has resulted to various scholars carrying out research on the benefits that large container ships may bring to the shipping industry.

As Jansson and Shneerson (1987) find, economies of scale have been realized as result of development of large container ships. Economies of scale have been derived on the connection between having high frequency services and optimizing the number and the size of the ships. The area between transshipment terminals and the ports affects large container ships. The load factor for the large container has improved resulting to lowering of the cost in cargo tonnage.

Development of transshipment terminals such as hubs where there is distribution system has been efficient since such terminals are in a position to accommodate large amount of traffic. Economies of scope have also been achieved as a result of sharing the transshipment facilities among many operators thus lowering the costs of transportation for both the owners of ships as well as the operators of such terminals. This in turn enhances the quality of infrastructure (Talley, 2009).

The number of port calls has reduced since the increase in the size of vessels. Port calls are very costly at the ports and to limit the cost the ship owners have to reduce the number of these port calls. Big ships today are operating as a global network and this calls for transshipment in order to fill them. As a result transshipment as a concept has also been developed. There has been change in the shipping networks that have change from point-to-point to distribution network comprising of spoke and hubs system. The network consists of crossroads called transshipment terminals, which connect short and long distances, and the various terminals

(Talley, 2009). The transshipment terminals stood at eighty five million TEU and are expected to grow to 184 million TEU by 2015 (Talley, 2009).

On the other hand, big ships are less flexible and this could have serious liability when it comes to downturn and this also increases the risk for the ship owners. Development of big ships calls for improvement of the ports. This is because large ships require longer berths, deeper waters, bigger cranes and bigger container yards. Increased time at the port facilities can outweigh benefits of economies of scale and therefore the facilities should be developed to reduce the amount of time that ships spend at the port (Ham, 2004).

2.3.3 Impact of Growth in Size of Ships

Development of large container ships has had an impact on the port labor because there has been speed efficiency in loading and unloading of cargo from the ship. With the introduction of large container ships fewer workers are required at the port. This has led to conflicts between the shipping companies and the labor unions as a result of having many of the workers being laid off (Rubbin, 2005).

Development of container ships has also had an impact on business practices and technology since container operations have come to demand technical skills required to operate the heavy machinery. The container size has been standardized so that the container ships can be used to carry a variety of cargo in the sea transport. The ships could be designed from the beginning in order to carry the containers. Uncertainty in the shipping industry has also been reduced since the companies are in a position to establish the speed of loading and unloading cargo. This has resulted to heavy investment to build big container ships to create a situation where economies of scale will be derived and enhance the ease with which loading and unloading are done as well as linking the shipping industry with other modes of transportation (Rubbin, 2005).

Developments in the size of container vessels have also had an impact on the ports and the cities where shipping activities are found. This means that the changes like lowered labor costs, increased speed of loading and unloading and the increased carrying capacity of the container ships have brought changes to the ports and cities (Talley, 2009). This has resulted to changes in the ports since deep waters are required for the large ships and the operations of the ports have also shifted to the nearby areas. For example, operations in the port of London and New York have shifted to Tilbury and New Jersey respectively. This growth of port has taken the form of expansion and consolidation of facilities in the areas found near the ports (Rubbin, 2005).

The increase in size of container ships has had a profound impact on the global economy of the world, for example, in the early 2000s there were about three hundred million twenty foot containers that were transported by the sea each year (Rubbin, 2005). It is evident that the development of large ships has influenced the international manufacturing systems and trade. The development of containerization has facilitated the process of globalization and the changes brought by it.

2.4 Optimal Ship Operations

Seaways are usually the most appropriate form of transport when it comes to the transportation of bulky goods over long distances. For instance, the South Asia Seaway is the main route connecting the South China Sea and the Indian Ocean. The seaway provides the shortest route that tankers trading among the countries of the Far East and the Middle East easily transport their goods (Roach, 2005). This infers that the route is very strategic for all traffic that enters and/or comes out of the Asia Pacific region. For instance, Roach affirms that approximately 60,000 vessels use the South East Asia region annually. The route is therefore a critical trade route to the world due to its strategic position and the economic importance to vessel transport sector in the world. Cowie (2010) affirms that South East Asia seaways are one of the most pivotal waterways in the world that have the longest and busiest used international navigation. This is because it provides a crucial link between the West and the East.

The significance of seaways can fully be appreciated if a major seaway route was to be closed. For instance, in the event of closure of the South East Asia trade route, it is believed that more than half of the fleet in the world will be forced to sail 500 miles more. This will negatively affect the world economy as it will definitely prolong the voyage times and it will likely affect vessels lifespan.

According to a study carried out by Brooks (2000) on liner shipping, optimal ship operations entail any aspect that contributes to minimizing costs and attaining the highest possible output. However, these optimal ships operations require all seaways to be safe regions for shipping activities to be successful. In understanding the concept of optimal ship operations, several factors have been advanced. Some of these factors are reviewed below.

2.4.1 Economics of Vessel Operational Cost

In a study undertaken by Stopford (2008), economics of vessel operational cost is recognized to have become an important factor in the last sixty years when international trade started to outgrow the gross domestic product of the world. In his study, Hoffmann (2010) affirms that this elasticity has become stronger over time since the volume of trade has grown three times faster than the world economy. However, Hoffmann continues to acknowledge that transport is one of the cornerstones of the international trade and globalization hence it has a big bearing to world economies. In relations to this, seaways play a more crucial role in international trade and globalization to bring about growth in world economies. To this end, seaways have occasioned several developments carried out in the seaways transport to maximize their operations.

Optimal ship operations are usual largely determined by the economies of scale that is again determined by some other elements. Some of these elements according to Stopford (2008) include capital costs, operating expenses and bunker costs. In addition, Cowie (2010) states that economy of scale in the shipping industry need to be considered since it is a key element in the sector. Cowie continues to postulate that in the economies of scale, larger ships usually cost less to build per cubed meter of carrying capacity compared to smaller ones. Therefore, to understand fully economics of vessel operational cost, other factors need to be examined.

2.4.2 Operating Costs

According to Stopford (2008), ship operations require high expenditure. These include crew, maintenance, administration, insurance cover and storage costs. In order for these operations to be on their optimal level, the operating costs need to be effectively and efficiently managed. For instance, Stopford continues to acknowledge that Emma Maersk 11, 000 TEU vessels was specifically designed for 13-member crew, which is fewer crew, compared to the one for 3000 TEU vessel ships. However, it is believed that other operating costs such as maintenance and insurance usually increase with the ship's capital cost though with less capacity for transport.

Moreover, the study did by Lorange (2009) affirm that in terms of operating costs, there is a need to have a low cost crewing in order to optimize operations of the ships in the seaways. In addition, the study suggests that a continued development of this crew is necessary to offer quality services in the ship operations. Quality of service is a prerequisite for optimal service operations as it helps to build strong good will in ships operations. Lorange believes that poor crew management and development are a contributory factor to poor service delivery, which in turn affects the overall ship operations. With poor service delivery, optimality becomes a pipe dream. However, operational costs of the ships depend on a variety of ever changing factors. For instance, Harwood (2006) states that crew matters will occasionally vary according to the number of the personnel at the time and their wages, which usually varies with time.

On the other hand, according to Yannopoulos (2002), the operating costs of the ships are usually affected by a large variety of protectionist devices. Flexibility is usually blocked in inter regional operations. This in turn results to ballast voyages that if combined with poor utilization during the off-season may heighten operational costs. In such cases, optimum operations become a tricky endeavor to be achieved through normal operations in the shipping industry.

Nevertheless, other regional policies categorize markets in segments by splitting it. This is an inhibiting factor in optimization of the ship operations. Jansson and Shneerson (2007) in their study on operational costs affirm that the overall utilization is adversely affected, as ship owners tend to use smaller vessels in such circumstances. This is not economically fit due to factors of economies of scale. Moreover, concomitant segmentation and subsequent shut down competition of shipping markets adds more disadvantages that are directly related with costs of ships operations. This kind of protectionist policies promotes monopoly of some few identified players in the industry that in turn hampers other players from attaining their optimal operations in the shipping industry.

2.4.3 Capital Costs

On the other hand, capital cost is taken to be a fixed cost that does not change per magnitude of the output. According to (Sys et al, 2008), capital costs are related to economies of scale since large ships usually cost less per container slot compared to smaller ones. For example, Stopford (2008) affirm that by the year 2006, 1200 TEU container ships cost 20, 000 dollars per slot while a 6500 TEU ship was costing 13,700 dollars per slot. This clearly indicate that the initial capital costs largely determines the optimal ship operations in terms of determining economies of scale which is an element of optimization of ship operations.

According to Harwood (2006), capital costs usually reduce as the ship ages but other costs such as voyage and operating costs increase relative to newer ships. It is therefore possible to deduce from this argument that optimal operations is achieved from more efficient engines of new ships compared to ageing ships. Ship operations that continually use old ships are likely to experience some technical problems that hinder smooth operations hence in the long run having problems achieving optimal operations required.

2.4.4 Port Charges

In the operations of ships in the seaways, there are some factors that are beyond control of ship owners. Port charges are a good example since ship owners are forced to abide by port charges, which are usually imposed by the port administration. Port charges are a requirement that all kinds of vessels using are obligated to observe when they dock at any port in their operations. These charges are paid in form of navigation service charges to ports authorities.

These charges usually vary from port to port depending on the prevailing economic structures adopted by port authorities. However, McLean and William (2010) hold that since these charges are usually determined by the ship's tonnage, element of economies of scale comes into force since charges relatively reduce as the ship becomes bigger. This implies that smaller ships usually feel the pinch of higher port charges while bigger ships pay less to their relative size. In relation to this, small ship sizes have proven to be a major bottleneck in the optimal ship operation.

Nonetheless, there are efforts to curb this bottleneck by coming up with new generation container ships. Jansson and Dan (1982) affirm that efforts made towards the development of container terminals towards larger and higher throughput capacity are in the positive direction of breaking the bottlenecks in order to optimize operations of ships. This optimization therefore calls for stakeholders in the shipping industry to use larger ships to benefit optimally from the economies of scale.

2.5 Major Developments that Determine Optimum Ship Operations

There exists several development dynamics that determines operations of ships to their optimal level. Ship operations do not exist in a vacuum but do exist in an environment that is prone to be either affected positively or negatively by the external environment. For instance, Yap (2009) affirms that factors like world economy, various government policies, global production, regulatory regimes, consumption patterns, and security issues are some of the issues that determine optimal ship operations.

Seaways spans across several states and/or regions and therefore different seaway sections are governed by policies of the state governing it. According to Yannopoulos (2002), these policies serve as restraints in achieving optimization of ship operations, which contrast which their intended role of promoting these operations. These restraints usually affect several aspects in the shipping industry. For instance, the policies determine a number of issues in the ships operations, which include freight rates, fleet sizes, service organizations and the employment patterns among others. Moreover and as Yannopoulos states, several government policies are only geared towards optimizing their taxes with little consideration on promoting optimization of ships operations in their seaways.

There have been developments in other industries, which have helped to bring optimization of ship operations. For instance, Hoffmann (2010) acknowledges telecommunication, trade liberalization and standardization in the international trade as factors that have helped to optimize these ships operations. For example, through telecommunication industry, effectiveness and efficiency of ports administration is achieved since telecommunication technologies have been integrated in their service delivery. This is a good recipe for achieving optimal ships operations since ports administration are improved.

On the other hand, trade liberalization is another important factor that has been adopted by various states to provide a leeway for optimal ships operations. Trade liberalization provides equal opportunities to all players in the shipping industry to advance their activities without any protectionist or favoritism to some operators. This provides a good ground for all players in the shipping industry to benefit equally from the prevailing conditions in the seaways transport industry.

2.6 Developments that Have Hindered Optimum Ship Operations

2.6.1 Economic Crises

Despite several developments taking place in the international trade, there have been other occurrences that have been detrimental to the well being of optimal ships operations. Kendall (2002) posits that global economic crises are one of the developments that have negatively affected the shipping industry. Hoffmann (2010) on the other hand affirms that economic crisis brought about financial losses for the operators in the shipping industry due to low freight and charter rates and downturn in trade volumes that resulted from the effects of economic crisis. For instance, Hoffmann acknowledges that Maersk Line which is one of the biggest shipping companies in the world posted a loss of 2.1 billion dollars in the year 2009 as a result of tough economic times at the moment. This economic crisis forced shipping industry to search for ways and means of cushioning itself in the looming crisis in order to prevent huge losses in their ships operations.

In relation to curbing losses from the economic crisis, the shipping industry undertook several measures that were detrimental in their operation and against optimization of the shipping operations. For instance, several players in the industry were forced to stop their new orders. According to Brooks (2000), in the year 2007 alone, 535 container ships were contracted while in 2008, 208 container vessels were ordered but in 2009 when the economic crisis reached its peak, only two orders were made by Maersk Line shipping company. This indicates that economic crisis had serious negative impacts to optimization of ships operations since full operational capacity could not be achieved during the crisis.

Moreover, as a result of the economic crisis, players in the shipping industry were forced to employ slow steaming practice in their operations. Kendall (2002) postulates that this strategy reduces voyage speed of ships, which implies that the industry has to use a large number of ships in order to maintain the same frequency. For instance, a service that usually takes seven vessels might require two ships, which are against the best practices for optimal ships operations. This economic crisis has been more destructive in meeting optimum operations since in such environments, the industry has limited options to expunge itself from the crisis.

2.6.2 Sail Propulsion

Historically, sea winds remain to be traditional source of ship propulsion. In the past, trade routes in the sea were designed to coincide with the prevailing patterns of seasonal winds and currents. Even today, small and medium sized ships are tailored to rely heavily on the sea currents and wind to aid in their propulsion. Optimal operations of these kinds of ships therefore rely heavily on these climatic conditions and in the event where sea currents and sea winds are not strong enough, operations of such ships are adversely inhibited.

However, Brabeck (2010) states that there have been some technological developments that have since been carried out in this area of ships propulsion that have in turn resulted to high and reliable performance technology. Brabeck acknowledge that skysails have been developed which uses large towing kites for the propulsion of the ship. This has helped to improve ship sailing process that is critical for optimum ship operations.

2.6.3 Piracy and its Effects to Optimal Ship Operations

According to Kwa and John (2007), the September 11th 2001 terrorist attack on the US exposed the vulnerabilities of the entire shipping sector, which included its infrastructure, the chain of supply and the vessel traffic. However, before the September incident, there were several terrorist attacks that had been directed towards the shipping industry but they had not received any substantial attention. For instance, Kwa and John affirm that in 1991, the Liberation of Tigers of Tamil Elam posed a great danger to the maritime industry through their incessant attacks on Sri Lankan installations. For instance, at one time the force attacked a Sri Lankan naval ship.

In connection with sea terrorism, another key challenge that faces seaways is the problem of piracy. According to Lehr (2007), the challenges posed by piracy are complex as they involve multifaceted incidents ranging from deception to multiple assaults on seamen and operators. By employing military warfare, pirates kidnap and take charge of vessels and go ahead to demand ransom from the operations. Going by the recent cases of piracy along the North Eastern coast of Africa, it is imperative to assert that most of the pirates' activities are always violent and sophisticated an indicator that it is very hard for the shipping management to counteract their activities since they are able to change tactics to evade any efforts of curbing them.

Furthermore, there are different levels of piracy that may be conducted in the seaways. These levels range from simple robbery that may target ship stores and any valuables at the anchor from the vessel. There also violent robberies where vessels at anchor or underway are attacked. Moreover, there may be deliberate vessel hijacks or what is commonly known as "phantom ship" operations, which usually cause huge losses (Lehr, 2007). All these terrorist attacks hamper smooth operations of ships and have adverse negative effects to optimal ship operations in the seaways.

In addition and according to Jose (2010), piracy is a major problem that poses a threat to sea transportation. Jose continue to acknowledge that if pirates activities are not well counteracted especially in South East Asia where the problem seems to be more rampant, ships operations in the region will be adversely affected despites the region's strategic importance to the global transport. To this end, it is arguable the shipping industry should focus more on ways of counteracting pirates activities since they pose a serious problem that is likely to hinder optimization of ships operations in the seaways.

2.7 The Link between Optimum Operations and Ship Size

Cullinane and Khanna (1999) link the operations of ships with their sizes by opining that large ships have access to limited ports as a result of the limited draught in many ports. This therefore implies that larger ships cannot serve large variety of ports available in most seaways thus they are hindered to achieve optimal services in their operations. However, it is also important to acknowledge that economy of scale is a key force behind larger ships calling only big ports and ignoring smaller ports.

However, Jansson and Shneerson (2007) affirm that not all ports have dedicated terminals that are capable of unloading some of the biggest ships. This implies that if a big ship docks to such terminals, the unloading process are likely to take much longer time hence time wastage is experienced in their operations. Such kind of poor arrangement by the port administrations prevents the bigger sized ships from attaining their optimal operations.

Furthermore, Kendall (2002) acknowledges that sizes of ships are determinant of speed in the ships operations. He points out that, ships with larger sizes sail at relatively higher speed than those with smaller capacity. This is so since larger ships need more port time as compared to the smaller ones and they are manufactured to sail at a much higher speed compared to smaller ones. Moreover, speed is of great importance to ships operations since they operate in a scheduled time frame and they are supposed to keep in pace with their schedules in order to avoid backlog of activities at sea ports.

Nevertheless, Roach (2005) holds that ships that are too large cannot achieve the required speed in their operations with a single propeller. Ships that are above 12000 TEUs therefore needs double propellers in order to maintain their required sailing speed in their operations. However, it is important to acknowledge here that with twin propellers, fuel and maintenance costs are likely to increase which in turn raise the operating cost.

It is also imperative to note that ports are the major determinants for the optimum operations of ships particularly in relation to their sizes. Operations of ships in these ports are determined by the size of the port since larger ships cannot operate effectively in a smaller port. This implies that port sizes are also a determinant when choosing ships that can be allowed to operate in a given route. Larger ships are therefore limited with ports of operations compared to smaller ones since they can only comfortably operate in larger ports.

3.0 CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter provides an extensive account of the methods utilized in the core processes of sampling and selection of study participants as well as the collection and analysis of data. The chapter assumes the "research process onion" advanced by Saunders, Lewis, and Thornhill (2003, p.83). Basically, this model entails the complete approach that begins with according the audience an opportunity to acquire less technical knowledge and proceeds to impart them with technical knowledge in a succession manner.

Figure 1: Espoused Research Process Onion

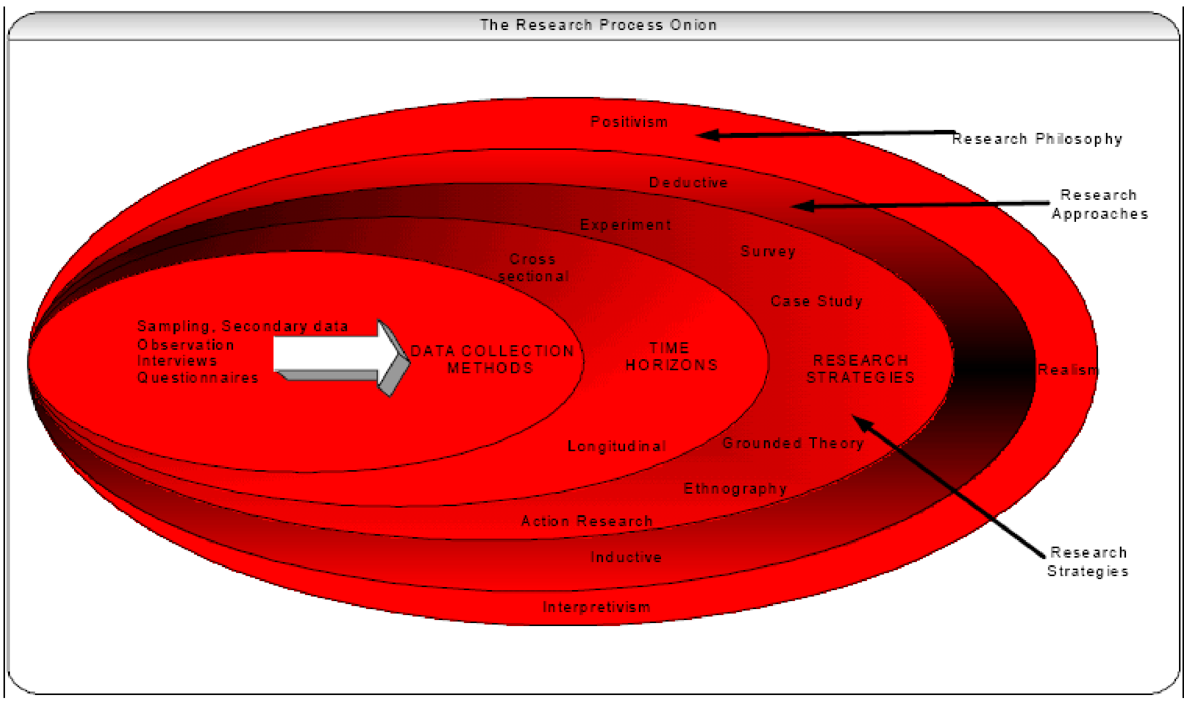

Figure 1 - Espoused Research Process Onion

3.2 Philosophical Framework

The intensive nature of this study topic demands a vibrant philosophical approach capable of not only unearthing the critical knowledge strands but most importantly, unearthing such knowledge strands using the most appropriate methods that are free from bias emanating from the researcher (Prasad, 2005). To this end, post-positivism was considered as the most appropriate philosophical approach. As Bryman and Bell (2007) clarify, the post-positivism philosophical framework entails the use of multiple methods of finding the truth where approaches mostly applied in studies falling in the realm of natural sciences are employed in social sciences studies as a way of enhancing the acquisition knowledge. These multiple methods allow the researcher to make adequate observations and/or extraction of critical information from human subjects taking part in a study while still maintaining a “good” distance from such participants. This approach was handy as it accorded the researcher an opportunity to collect and analyze data as an outsider without any potentialities of bias and/or emotional judgments (Blaxter, Hughes & Tight, 2006, p.60).

3.3 Research Design

According to Creswell (2003) studies that fall within the social sciences realm should utilize qualitative research designs. Creswell substantiates this claim by asserting that unlike quantitative approaches, qualitative designs accord the researcher an opportunity to adequately understand the participants well by factoring-in the social indicators of their environments during the process of data collection. In addition, a qualitative research design was phenomenal in enabling the researcher to capture large chunks of data even in instances when the participants did not provide enough responses to questions. This is because post-positivist qualitative approaches are not entirely dependent on the participants' explicit answers as they also rely on a wide range of knowledge-enhancing cues (Prasad, 2005).

3.4 Study Population

This study population will be made up of management staff drawn from Maersk Line as well as major port terminals at the Malacca Straits route. As explained in the introduction part, Maersk Line is the global leader in liner shipping in terms of the amount of cargo hauled to various global destinations as well as the number of vessels deployed in various routes globally. On the other hand and as explained in the introduction section, the Malacca Straits is one of the busiest shipping routes in the world that connect leading Asian economies such as China, India, South Korea, and Japan. With this in mind management staff from two of its major ports (Johor Port and Port of Singapore) was considered for the study.

3.5 Sample and Sampling Methods

The study sample was made up of 30 management staffs. The participants were selected based on their willingness, length of service (at least five years), and their positions. The researcher used employees from each of the three organizations (Maersk Line, Johor Port and the Port of Singapore) to select potential participants as per the selection criteria. Using the three lists of potential participants, the researcher prepared letters and E-mailed them to the potential participants. The participants were given a period of two weeks to fill to respond to the letters.

In total, there were 68 positive responses – 25 from Maersk Line, 19 from Johor Port, and 24 from the Port of Singapore. Then using random sampling method, the researcher selected 10 participants from each of the three organizations. The random sampling process was done based on a random number generator that randomly generated ten numbers, that is, between 1 and 25 for Maersk Line, between 1 and 19 for Johor Port, and between 1 and 24 for the Port of Singapore. The three sets of random numbers added up to make the 30 study participants. The rationale behind the random-based sampling was based on the notion that, the method is always free from researcher bias (Dattalo, 2010).

3. 6 Data Collection

The choice of online communication was necessary given the distance between the researcher and the participants. Again, it was thought necessary to use a method of interviewing that did not interfere with the participants' busy schedule. Respondents were given ample time to answer and react to the questions, each question at a time.

3.7 Data Analysis

Due to its intensive nature, the study generated complex data. To this effect, it was considered appropriate to subject the data to a thorough and contextual qualitative method of analysis. The researcher therefore employed a continuous qualitative data analysis method of coding and memoing. This method was necessary as it enhanced the ease with which data was processed – the data analysis processed concurrently with the data collection process.

The first step involved the transcribing of the data into interpretable format. The next step will involve studying the data to identify the salient points that will be jotted down (coding) in clusters. Then from these codes the researcher wrote short memos (memoing). The last step involved subjecting the memos into ad hoc process that involved the use of frequency tables and charts (David & Sutton, 2004).

3.8 Ethical Assurances

Before carrying out the core processes of sampling and data collection, the researcher undertook to assure the participants of the following core ethical indicators:

a. Participation was entirely based on personal willingness.
b. The researcher will rely on the information the participants were willing to divulge.
c. Participants were not under any obligations to answer all the questions.
d. Participants were free to withdraw from the study at any stage.

3.9 Limitations of the Research

By employing a post-positivism framework the researcher undertook to ensure that high levels of validity and reliability were maintained throughout the core processes of sampling, data collection, and analysis. Even so, it was hard to completely rule out problems and/or limitations. To this end, the study encountered a number of limitations related to:

a. Time – though the researcher had prepared a work plan for the whole study it was very hard to work within the timelines, as sometimes the participants did not honor their obligations.
b. Finance – the researcher experienced substantial constraints related to money particularly in funding some of the intensive processes such as sampling and data collection.

4.0 CHAPTER 4: RESULTS

4.1 Introduction

This chapter covers a brief presentation of the analyzed study results. The presentation of the chapter was based on the overarching study aim as well as the achievable and measurable study objectives listed in the first chapter of this study. To this end, the chapter is divided into four sub-sections. The chapter merely presents the results as they were analyzed and does not provide any discussion and/or interpretation of such results, as this will be done in the discussion chapter.

4.2 Enhancement of Optimum Ship Operations at the Malacca Straits Route.

In response to the interview questions investigating whether the new Maersk 18,000 TEU vessels will enhance optimum operations at the Malacca Straits, the participants gave the following responses.

Table 1 - Enhancement of Optimum Ship Operations at the Malacca Straits Route

Response	Roll	Percentage (%)
Yes	26	86.7
No	3	10
No Response	1	3.3

4.2.1For

- Will lead to economies of scale.
- Will lead to the sharing of terminals and other facilities.
- Will lead to increased pace of hauling heavy and bulky goods from one port to another.
- Will lead to more alliances.

4.2.2 Against

- Will increase risks occasioned by perennial threats such as pirates.
- Will lengthen offloading and loading time.
- Will increase insurance and maintenance costs.

4.3 Reduction of Operational Costs at the Malacca Straits Route.

In response to the interview questions investigating whether the introduction of the new Maersk 18,000 vessels will help reduce operational costs at the Malacca, the following responses were captured.

Table 2 - Reduction of Operational Costs at the Malacca Straits Route

Response	Roll	Percentage (%)
Yes	20	66.7
No	8	26.7
No Response	2	6.7

4.3.1For

- Capital costs will decrease in the long run.
- Port charges will decrease in the initial years of operations.
- Maintenance costs will decrease in the initial years.
- The cost of fuel will drastically reduce.
- The crewing costs will decrease.
- Port call costs will drastically reduce.

4.3.2 Against

- Maintenance costs will increase in the long run.
- More fuel will be required to run the twin-propeller engines.
- High costs for renovating existing ports.

4.4 Efficiency Enhancement at the Malacca Straits Route.

In response to the interview questions investigating whether the new Maersk 18,000 TEU vessels will enhance efficiency of operational efficiency at the Malacca Straits, the participants gave the following answers.

Table 3 - Efficiency Enhancement at the Malacca Straits Route

Response	Roll	Percentage (%)
Yes	23	76.7
No	6	20
No Response	1	3.3

4.4.1 For

- Overall, goods will be moved faster.
- There will be more cooperation between operators.
- The overall throughput will increase.
- More goods will be transported.
- Terminals will undergo a facelift to improve on their service delivery.

4.4.2 Against

- Loading and offloading will be slow and cumbersome.
- Seamen will have to undergo training on how to handle the new vessels.
- Will cause congestions on the narrow sections of the strait.

4.5 Reduction of Greenhouse Gases Emitted in the Malacca Straits Route.

In response to the interview questions investigating whether the new Maersk 18,000 TEU vessels will help reduce the amount of greenhouse gases emitted in the Malacca Straits, the participants gave the following answers.

Table 4 - Reduction of Greenhouse Gases Emitted in the Malacca Straits Route

Response	Roll	Percentage (%)
Yes	25	83.3
No	3	10
No Response	2	6.7

4.5.1 For

- The new vessels will emit the record lowest greenhouse gases.
- The twin engines will consume less fuel than existing largest ships (Emma Maersk).
- The twin-engine will have a heat recovery system that captures back waste heat for reuse.
- A "cradle-to-cradle passport" will accompany the ship.

4.5.2 Against

- Large ship with large engines will consume more fuel.
- Large ships will emit more greenhouse gases.

5.0 CHAPTER 5: DISCUSSION

5.1 Introduction

The previous chapter presented the analyzed research results. This chapter relied on the results presented in the previous chapter and interpreted and drew meaning from them. In achieving this, the chapter will rely on the secondary information presented in the literature review chapter. The chapter is structured into four subsections in conformity with the study objectives.

5.2 Enhancement of Optimum Ship Operations at the Malacca Straits Route

The results show that majority of the participants (86.7 percent) were in agreement that the Triple-E vessels will enhance optimum operations at the Malacca Straights as they will enhance economies of scale, sharing of critical infrastructure among operators, increased pace of hauling cargo as well as heightened chances of alliance formulation. These findings confirms to concept of optimum ship operations, which according to Sys et al (2008), entails minimizing the operational costs per TEU. After all, this was the main reason why Maersk ordered the larger vessels (Maersk, 2011). This argument is emboldened by the fact that the new vessels will lead to economies of scale, and most importantly, will be energy efficient, and environmentally friendly. If the new vessels will consume less fuel, emit less greenhouse gases, and improve on efficiency, then other operational and capital costs such as insurance will drastically reduce. This will therefore reduce the costs of transporting a single TEU.

Cullinane and Khanna (2000) clarifies that economies of scale in the shipping industry is achieved as the cost per TEU decreases as the size of the vessel increases. This is because the costs of building a bigger ship are less than that of a small ship since the increase of manufacturing costs is inversely proportional with the increase in ship size. Again, the increase in maintenance costs is inversely proportional to the increase in ship size, as big ships require relatively less crew than smaller ship. Assuming that all other factors will be constant, it is anticipated that the Triple-E class vessels will enhance optimum operations at the Malacca Straights. The argument is captured by the following table; this table shows that operations costs decrease with the increase in ship size.

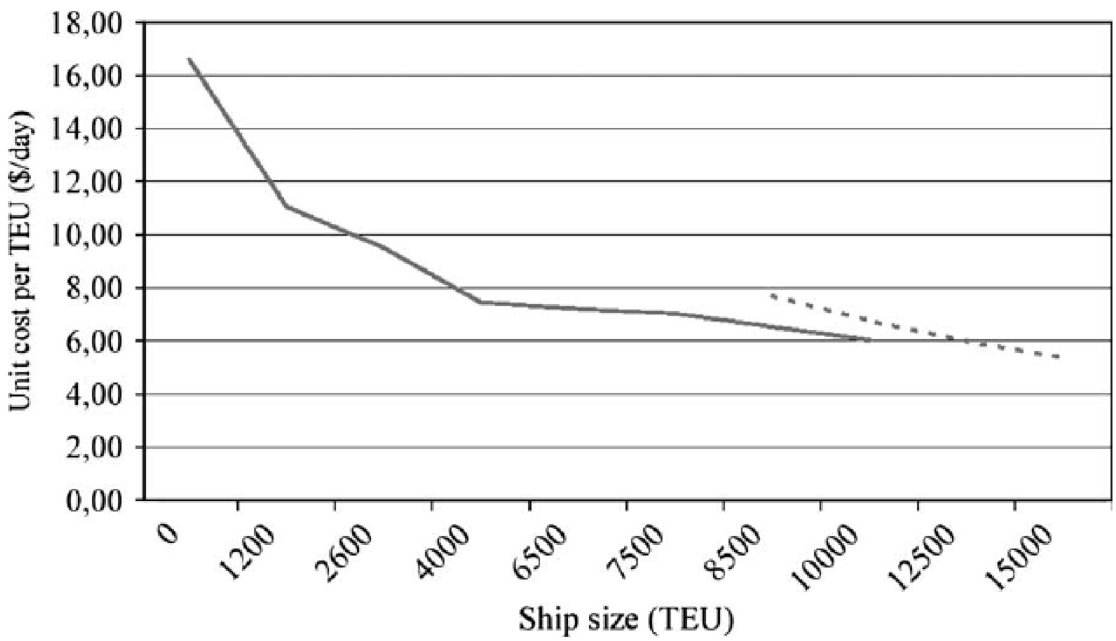

Figure 2 - Economies of Scale in the Shipping Industry
Source: Sys et al (2008, p.446)

As the following table shows, optimum ship operation will be achieved because large ships will carry larger amounts of cargo at lower cost per TEU.

Table 5 - Comparative Analysis of Ship Operation Cost via-a-vis Ship Size (,000$)

	5600		6500		8400		9600	
	$	%	$	%	$	%	$	%
Crew Salary	168	5.72	180	5.17	192	4.63	210	4.32
Insurance	120	4.08	140	4.02	170	4.10	200	4.11
Vessel Management	36	1.23	43	1.23	50	1.21	60	1.23
Port Dues	900	30.63	1080	31.00	1305	31.45	1620	33.31
Bunker (at sea)	821.4	27.95	985.68	28.29	1149.96	27.72	1314.24	27.02
Repair	180	6.13	220	6.32	260	6.27	300	6.17
Bunker (in port)	17.982	0.61	19.98	0.57	21.978	0.53	23.976	0.49
Reserves	120	4.08	140	4.02	170	4.10	200	4.11
Materials	175	5.96	200	5.74	230	5.54	260	5.35
Devaluation	400	13.61	475	13.64	600	14.46	675	13.88
Total	2938.4	100.00	3483.66	100.00	4148.94	100.00	4863.216	100.00

Source: Xiaodi (2007, p.35).

5.3 Reduction of Operational Costs at the Malacca Straits Route

As the results show, as many as 66.7 percent of the participants expressed their agreement with the conclusion that the new vessels will reduce operational costs. The new Maersk 18,000 TEU vessels are made in response to the growing demand for cheap, energy efficient and environmentally friendly vessels capable of leveraging the unforeseeable industry shocks. Even so, it is wise to point out that Maersk will pay huge amounts of money (capital costs) for the delivery of the Triple-E vessels. Perhaps the 10 percent participants who did not agree that the new vessels would cut down costs had this in mind.

Nevertheless and going by the fact that the new ships will have very powerful engines capable of making them travel faster than any other ship, it will mean that costs occasioned by delays will be greatly reduced. Moreover, there should be no worries as capital costs will reduce in the long run, port charges will decrease in the initial years of operation, maintenance costs will decrease in the initial years, cost of fuel will drastically reduce, port call costs will reduce, and that crewing costs will decrease.

This is in line with the following table that was adapted from Xiaodi (2007) showing the voyage costs for various sizes of ship serving the Chinese ports. It is more economical when transporting cargo in a large ship than in a small one.

Table 6 - Voyage Costs for Various Sizes of Ships Serving Chinese Ports

	Unit	1	2	3	4	5	6
Tonnage	Ton	40000	50000	60000	80000	80000	100000
Capacity	TEU	2761	3764	4422	5250	8736	12154
Pilotage	RMB	20000	25000	30000	40000	40000	50000
Berth leaving	RMB	8800	11000	13200	17600	17600	22000
Mooring	RMB	213	213	213	213	213	213
Anchorage	RMB	8000	10000	12000	16000	16000	20000
Total	RMB	37013	46213	55413	73813	73813	92213
Unit cost	RMB	5.08	13.41	12.28	12.53	14.06	8.45

Source: Xiaodi (2007, p.33).

Moreover, the finding that the introduction of the Maersk 18,000TEU vessels will reduce the operational costs is consistent with an industry analysis carried out by Drewry (cited in Xiaodi, 2007). This analysis shows that the voyage costs for a 4000TEU vessel is higher by a 21 percent margin compared to a 6000TEU vessel. This finding is also supported by the following table which breaks down fuel costs for various ship sizes. As it shows, the cost of fuel per ton for large ships is lower than for smaller ships.

Table 7 - Cost of Fuel per Unit (ton)

Tonnage	Consumption everyday	Loading quantity each year	Fuel cost per unit(pound/tom)
15 000	23	120 000	55
30 000	41	242 000	48
50 000	55	412 000	38
80 000	75	663 000	31

Source: Xiaodi (p.34).

5.4 Efficiency Enhancement at the Malacca Straits Route

Overall, 76.7 percent of the participants gave a positive answer to the interview questions seeking to establish whether the new vessels will induce efficiency at the Malacca Straights against a 20 percent who gave a negative answer. The remaining percentage did not provide an answer for these questions. This can be interpreted as a sign that there was an agreement that the new vessels will enhance efficiency. This finding is in agreement with Yap (2009) who found that big vessels enhance efficiency as the overall costs per TEU reduce with the increase of size. Perhaps this is because McLean and William (2010), ship operations are greatly determined by size. Things like the crewing capacity, energy consumption, as well as the stowage capacity are varied across ship sizes, as it is easy to work with large ships than small ones (Roach, 2005).

Even so, 20 percent of those who gave a negative response seemed to have a different idea, perhaps based on Cullinane and Khanna (1999) argument that large ships have a limitation of ports that they can effectively dock. Only ports with sufficient draught can accommodate large ships. Again and as Jansson and Shneerson (2007) states, most ports are yet to put in place proper loading and unloading facilities for large ships meaning that large ships will take a lot of time in such terminals. However, basing on the notion that optimum operations is determined by a wide range of factors (Sys et al, 2008), it is only wise to point out that the finding that the new vessels will enhance efficiency at the Malacca Straits is justified. Moreover and as Xiaodi (2007) shows, major shipping ports along the Malacca Straits and in the greater Asia pacific region have instituted major strategies aimed at deepening the ports. As shown in the following table, the future of many Malacca Straits ports seems brighter at least when using observations made between 2005 and 2006.

Table 8 - The Present Situation as well as the Future Projections for Major Aisan Ports

Port	Singapore	Hong Kong	Kaohsiung	Busan	Kobe	Shanghai
Owning berths over 15 meter in depth	8	4	3	8	5	0
Planning to build berths over 15 meter in depth	10	6	4	15	4	5
Planning year	2006	2007	2006	2006	2005	2005

Source: Xiaodi (2007, p.27).

Furthermore, efficiency will be enhanced given that 18,000TEU vessels will be sailing at a faster speed compared to smaller ships. Based on Xiaodi (2007) and while going by the change in speed between fourth generation and fifth generation vessels, it is projected that the speed for the 18,000TEU will increase by a margin of between 3 and 4 knots.

5.5 Reduction of Greenhouse Gases Emitted in the Malacca Straits Route

Ships emit a lot of greenhouse gases during their normal voyages. 83.3 percent of the participants indicated that the introduction of the new Triple-E vessels in the Malacca Straits will help reduce the emission of greenhouse gases as the vessels have less fuel consumption and less carbon emission. Only a small percentage, 16.7 percent of the participants gave a negative or did not give any response at all. To this end, it can be concluded that this study found out that the new vessels would have a positive impact on the Malacca Straits in regards to the emission of greenhouses.

This finding, agrees with research carried out by Maersk team of engineers before placing the order for the super vessels. As a matter of fact, evidence shows that the new vessels will emit 20 percent less carbon when compared to Emma Maersk, the largest vessel in operation so far. This will be more than 50 percent the average carbon emission by most ships today, a testimony that the new vessels will be environmentally friendly (Maersk, 2011).

6.0 CHAPTER 6: CONCLUSION

This study has provided an intensive analysis of the impacts of the new Maersk 18,000 TEU vessels on the Malacca Straits route. To this end, it has provided that the new ships will bring with them several positive factors to the Malacca Straits sea route. The study has provided that the new vessels will enhance optimum operations at the Malacca Straits as it will help reduce the totals costs incurred per TEU while at the same time providing reliable and cheap carriage space for goods coming out and/or entering the Asia Pacific region. It has been established that the new vessels will lead to cost reduction as they will spend less fuel, they will require less crews, and that they will enhance economies of scale as it will be cheaper to transport bulk goods in a large vessel. The new vessels will also sail at a faster speed meaning that it will be more economical to transport bulk goods from port of origin to port of destination. This will enhance efficiency as it will cushion the amount of time spend during loading and offloading. Lastly, the study established that the new vessels would lead to less carbon emission, a reduction of a 50 percent margin.

Conclusively, it is arguable that the size of ships has been a very critical factor in the enhancement of optimum ship operations. As literature review, results and discussion chapters show, ship builders have over the years continued to increase the size of ships in reaction to the results of economic analyses on the relationship between ship size and optimum operations. To this effect, it is anticipated that the new Maersk 18,000 TEU vessels will not lead to reduced operation costs but will enhance efficiency at the Malacca Straits route.

REFERENCES

Blaxter, L. Hughes, C. & Tight, M, (2006). *How to research.* Berkshire, England. Open University Press.

Brabeck, S. (2010). *Skysails-Using Wind Power Profitability*. GmbH & Co: Germany.

Brooks, M. R. (2000). *Sea Change in Liner Shipping: Regulation and Managerial Decision-Making, in a Global Industry.* Oxford: USA.

Bryman, A. & Bell, E. (200&). *Business research methods*. oxford New York, NY: Oxford University Press.

Cowie, J. (2010). *The Economics of Transport: A Theoretical and Applied Perspective*. Routledge: Canada.

Creswell, J.W. (2003). *Research design: qualitative, quantitative, and mixed methods approach*. Thousand Oaks, CA: Sage.

Cullinane, K. & Khanna, M. (1999). Economies of scale in large container ships. *Journal of Transport Geography*, 33(2); 185-208.

Cullinane, K. & Khanna, M. (2000). Economies of scale in large containerships: Optimal size and geographical implications. *Journal of Transport Geography*, 8(3); 181-195.

Dattalo, P. (2010). *Strategies to approximate random sampling and assignment*. Oxford, Oxford University Press.

David, M. & Sutton, C.D. (2004). *Social research: the basics*. London: SAGE.

Foster, N.M., Cicin-Sain, B. & Knetcht, R.W. (1999). *Trends and Future Challenges for U.S. National Ocean and Coastal Policy August 1999*. USA: DIANE Publishing.

Freeman, D.B. (2003). *The Straits of Malacca: gateway or gauntlet*? Quebec, Canada: McGill-Queen's University Press.

Gwillian, K. M. & Molenaar, H. J. (1993). *Current issues in maritime economics*. The Netherlands: Kluwer Academic Publishers.

Ham, J. C. (2004). The feasibility of mega-container vessels in *International Journal of Transport Economies, Engineering and Law,* 25, 89-98.

Harwood, S. (2006). *Shipping Finance*. Euromoney International Investor Plc: London.

Hoffamann, J. (2010). Shipping out of the Economic Crisis. *The Brown Journal of World Affairs*. Vol. 16, no.2.

Imai, A., Nishimura, E., Papadimitriou, S. & Liu, M. J. (2006) .The economic viability of container mega-ships. *Transportation Research Part E-Logistics and Transportation Review,* 46(1), 21-41.

Jansson, J. O. & Shneerson, D. (1987). *Liner Shipping Economics*. New York: Chapman and Hall.

Jansson, J. O. & Shneerson, D. (2007). The optimal ship size, *Journal of Transport Economies and Policy*, 16(3); 217-238.

Jansson, J., & Dan, S. (1982). *Port Economics*. Massachusetts Institute of Technology Press: USA.

Kendall, P. M. (2002). The theory of optimal ship size, *Journal of Transport Economies and Policy*, 6(2); 128-146.

Kwa, C, & John, S. (2007). *Maritime Security in Southeast Asia*. Routledge: USA.

Lehr, P. (2007). *Violence at Sea: Piracy in the Age of Global Terrorism*. Routledge: USA.

Leifer, M. (1978). *Malacca, Singapore, and Indonesia*. Alphen aan den Rijn, The Netherlands: Sijthoff International Publishers BV.

Lim, S. (1998). Economies of scale in container shipping. *Maritime Policy and Management*, 25(4), 361-373.

Lloyd's Register (2011). I*nfosheet No. 30: Modern ship size definitions*. Retrieved May 19, 2011, from www.lr.org/Images/30%20ship%20sizes_tcm155-173543.pdf

Lorage, P. (2005). *Shipping company strategies: global management under turbulent conditions*. Amsterdam, The Netherlands: Elsevier B.V.

Lorange, P. (2009). *Shipping Strategy: Innovating for Success*. Cambridge University Press: New York.

Loyola University Chicago (2011). *The demise of ocean shipping regulation: a study in the evolution of competition policy and the predictive power of microeconomics*. Retrieved May 19, 2011, from http://www.luc.edu/law/academics/special/center/antitrust/pdfs/sagers_shipping_act.pdf

Madison, D.S. (2005). *Critical ethnography: method, ethics, and performance*. Thousand Oaks, CA: Sage.

Maersk Line Shipping Containers Worldwide, (2011). Retrieved May 24, 2011, from: www.maerskline.com/

McLean, A, & Willium, B. (2010). *A Simulation Approach to the Evaluation of Operational Costs and Performance in Liner Shipping Operations*. University of Louisville: USA.

Prasad, P. (2005). Crafting qualitative research: working in the post-positivist traditions. Armonk, NY: M.E. Sharpe, Inc.

Roach, A. (2005). Enhancing Martime Security in the Straits of Malacca and Singapore. *Journal of International Affairs.* 59(1).

Rosenberg, D. (2010). "The Political Economy of Piracy in the South China Sea", in Elleman, B.A, A. Forbes, and D. Rosenberg (eds). *Piracy and Maritime Crime.* Naval War College Newport Papers, Newport: Naval War College Press.

Rubbin, J. (2005). *Antarctica: Lonely Planet Antarctica*. Lonely Planet.

Stopford, M. (2008). *Maritime Economics*. Routledge: Canada.

Sys et al (2008). In Search of the Link between Ship Size and Operations in *Transportation Planning and Technology*, 31(4), 435-463.

Talley, W.K. (2009). *Port Economics:* New York, NY: Taylor & Francis.

Tryfos, P. (1996). *Sampling methods for applied research: text and cases*. New York, NY: John Wiley.

Yannopoulos, G. (2002). *Shipping Policies for an Open World Economy*. Routledge: London.

Yap, W. (2009). *Container Shipping Services and Their Impact on Container Port Competetiveness*. Uitgeverij UPA University Press: Brussels.