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ΠΕΡΙΛΗΨΗ

Η σημαντικότητα της κατανάλωσης ναυτιλιακών καυσίμων των πλοίων ξηρού φορτίου χύδην αυξήθηκε κατά τα έτη στην βιομηχανία ξηρού χύδην φορτίου, καθώς τα έσοδα των πλοίων μειώθηκαν απότομα λόγω ορισμένων παραγόντων, κυρίως λόγω της υπερπροσφοράς των πλοίων στην αγορά. Με βάση το συναίσθημα της συλλογικής και ατομικής αγοράς, οι απόψεις ποικίλλουν ως προς το εάν πρόκειται για μια ευκαιρία για επενδύσεις με χαμηλό κόστος που θα αποπληρωθούν σχετικά γρήγορα λόγω της κυκλικότητας της αγοράς ξηρού φορτίου ή για μία περαιτέρω μείωση στην αγορά χρονοναύλωσης και στις τιμές των ναύλων ήδη μειωθεί.

Μέσα στα τελευταία χρόνια εισήλθε στην αγορά ένας μεγάλος αριθμός νεοσύστατων πλοίων και είναι αμφίβολο κατά πόσον η ζήτηση φορτίου θα είναι σε θέση να αντισταθμίσει την αύξηση της προσφοράς πλοίων. Δεδομένου ότι οι υπηρεσίες που αφορούν την αγορά καυσίμων αποτελούν ένα από τα σημαντικότερα τμήματα του παγκόσμιου εμπορίου πετρελαιοειδών, ο στόχος αυτής της διατριβής είναι η ανάλυση του επιπέδου της επίδρασης της οικονομικής απόδοσης στην ανταγωνιστικότητα των φορτηγών πλοίων μεταφοράς χύδην ξηρού φορτίου.

Η ακόλουθη έρευνα εκπληρώθηκε εξετάζοντας τα πρότυπα προσφοράς και ζήτησης με την πάροδο των ετών στη ναυτιλία ξηρού χύδην φορτίου και την επίδρασή της στο κόστος και την κατανάλωση καυσίμων, εξετάζοντας το κόστος ταξιδιού των πλοίων για βέλτιστη οικονομική αποδοτικότητα και τους διάφορους λόγους που προκαλούν διακυμάνσεις της εμπιστοσύνης των ενδιαφερομένων μερών. Η ανάλυση της οικονομικής απόδοσης που σχετίζεται με την κατανάλωση καυσίμων περιλάμβανε τις μεταβολές της εμπιστοσύνης των εμπλεκόμενων φορέων όσον αφορά την αποδοτικότητα των καυσίμων, δεδομένου ότι οι έρευνες έδειξαν ότι η κατανάλωση καυσίμου είναι ζωτικής σημασίας για την οικονομική αποτελεσματικότητα όταν μειώνονται οι τιμές των ναύλων. Διαπιστώθηκε ότι τα πλοία με κορυφαία απόδοση βασισμένα σε πρότυπα αναφοράς, ήταν πιο αποδοτικά στην κατανάλωση καύσιμων από τα πλοία με χαμηλό κόστος αγοράς, δείχνοντας μια άμεση συσχέτιση μεταξύ οικονομικής απόδοσης και κατανάλωσης καυσίμων.

Τα αποτελέσματα υποδεικνύουν επίσης ότι η απασχολησιμότητα των φορτηγών φορτίου χύδην ξηρού φορτίου συνδέεται με την κατανάλωση καυσίμων, καθώς η εμπιστοσύνη των ενδιαφερομένων αντιλαμβάνεται ότι η συγκριτικά μικρότερη κατανάλωση καυσίμων σε σχέση με τα ανταγωνιστικά πλοία είναι ευεργετική. Ωστόσο, δεν μπορεί να ειπωθεί με βεβαιότητα ότι κάθε πιθανό κόστος για την παραγγελία ενός πλοίου το οποίο θα έχει ιδιαίτερα αποδοτική κατανάλωση καυσίμου θα παράσχει τη βέλτιστη επιλογή. Συνολικά, θεωρείται ότι η ενεργειακή απόδοση είναι ο σημαντικότερος παράγοντας για την επίτευξη συγκριτικού πλεονεκτήματος έναντι των ανταγωνιστικών σκαφών.

ABSTRACT

The significance of the fuel consumption of dry bulk cargo vessels has increased of the years in the dry bulk industry, as vessel revenues have dropped sharply due to a number of factors, the primary being vessel oversupply in the market. Based on the collective and individual market sentiment, views are diverse as to whether or not this is an opportunity for cheap investment that will pay off due to the cyclicality of the dry cargo market, or further depress the already low time charter and freight rates.

Within the last years a vast number of newly built ships entered the market and it is questionable whether or not cargo demand will be able to offset the increase in ship supply. As market bunkering services forms one of the most important segments of world oil products trade, the aim of this dissertation was an analysis of the level of impact of economic efficiency on the competitiveness of bulk carriers.

The following research was fulfilled by examining supply and demand patterns over the years in dry bulk shipping and its effect on fuel cost and consumption, examining the voyage costs of vessels for optimum economic efficiency, and the several reasons that cause fluctuations in stakeholders' confidence. As of such, the analysis of economic efficiency related to fuel consumption included the consequent stakeholders' confidence alterations toward fuel efficiency, since research showed that fuel consumption is of vital importance to economic efficiency when charter rates drop. It was found that top performing vessels based on a benchmark standard, were more fuel efficient than the market laggard vessels, showing a direct correlation between economic efficiency and fuel consumption.

Outcomes also indicated that employability of bulk carriers is linked with fuel consumption, as the confidence of stakeholders perceives the comparably lower fuel consumption in relation to competitor vessels as beneficial. However, it cannot be said with certainty that any possible cost for ordering a fuel efficient vessel will provide the optimum choice. Overall, it is considered that energy efficiency is the most important factor for gaining a comparative advantage against competitor vessels.

Keywords: Bunkering, fuel consumption, dry bulk, cargo vessels, efficiency, confidence, stakeholders.

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LIST OF ABBREVIATIONS

ECB	European Central Bank
ABT	About
BAF	Bunker Adjustment Factor
BDI	Baltic Dry Index
BPI	Baltic Panamax Index
COA	Contract of Affreightment
CONS	Consumption
CST	Centistoke
DWT	Deadweight
DWAT	Deadweight All Told
FFA	Forward Freight Agreement
G/E	Generator Engine
GDP	Gross Domestic Product
IFO	Intermediate Fuel Oil
IMO	International Maritime Organization
LME	Large-Modern-Economic
LNG	Liquefied Natural Gas
M/E	Main Engine
MDO	Marine Diesel Oil
MGO	Marine Gas Oil
MT	Metric Tones

LIST OF ABBREVIATIONS

MTRS	Meters
MV	Motor Vessel
NOPAC	North Pacific Ocean
TCT	Time Charter Trip
USD	United States Dollars
USG	United States Gulf

1. SHIPPING INDUSTRY

1.2 INTRODUCTION

Shipping can be described as an essential link in international trade, since ocean-going vessels represent the most efficient method of transporting basic commodities and finished products, and it is often the only method available for the carriage and movement of goods (Genco Shipping, 2012). Additionally, the maritime industry is responsible for transporting more than 90% of the world's goods through the high seas, classing the industry as a vital contributor towards the global economy, as by 2006 'approximately 2.7 billion tons of dry bulk cargo was transported by sea, comprising more than one-third of all international seaborne trade' (Genco Shipping, 2012).

In the aftermath of the global financial crisis lower demand from the advanced economies destabilised the balance between supply and demand globally. The bitter legacies of the financial crisis have been high levels of debt and high unemployment, problems that too many countries are still struggling to overcome. Many companies and households are still cutting back on investment and consumption because they are concerned about low future growth. Governments and central banks have tried to combat this cycle by slashing interest rates and pursuing other stimulus measures. Many have cut rates to historically low levels, some even negative, in order to generate economic growth.

In 2016 the world is expected to grow by 3.8 percent, up .03 percent from 2015. There are uneven prospects across the board causing uncertainty around this projection. The main advantage providing a boost to the economy is the increase in disposable income due to the lower oil prices. The adjustments in the U.S. dollar, weakening most of the other currencies; the geopolitical uncertainty in the Russia-Ukraine area and the Middle East; and the ongoing concern about the European Union are all causing a wave of ambiguity for the expected growth rate.

According to the World Trade Organization Economist, in 2016 world merchandise trade volume will rise to 4 percent. This is still far below the annual average of 5.1 percent, which was announced in 1990. The same factors holding back

the global growth rate are affecting the world wide trade rate. Geopolitical tensions and fluctuations in the exchange are two key factors causing sluggish growth.

Overall, trade growth will surpass global growth as a whole for 2016, but only by a small margin. This should aid the transportation industry in growth, but the overall world growth is difficult to predict.

The shipping industry continues to recover from a 5-year downturn, which had been driven by overcapacity and caused freight rates to drop. Dry ships are projected to have the strongest levels of recovery due to supply increases in commodities such as iron ore and coal. Tanker rates will be up as fleet growth slows.

In particular, the sharp decline in oil prices since mid-2014 is supporting global activity and helping offset some of the headwind for growth in oil-importing economies. Lower commodity prices are leading to sizeable real income shifts from the commodity-exporting to commodity-importing economies. If consumer prices start to declines and stay depressed over a period, it may postpone households and businesses spending and investment decisions. The risk is that such development could trigger a downward spiral in economic activity, prices and world trade. Deflation also makes it harder for countries to pay off debts, and can force weak economies to cut wages in order to compete globally.

Bunker fuel is primarily consumed by marine vessels such as bulk and general cargo vessels, tankers, container ships, offshore port vessels, and ferries. Since ferries and support vessels spend their maximum voyage time within ECAs, shipping companies operating these vessels are gradually shifting from traditional engines to LNG-fuelled vessels. Hence, ferries and offshore support vessels account for a major share of the global LNG bunker fuel market. Rising container traffic in both Europe and Asia Pacific will boost the adoption of LNG as a bunker fuel by containers in both the regions.

The global bunkering market has been segmented as below:

End User Analysis

- Container Vessels
- Tankers Vessels
- Bulk & General Cargo Vessels
- Ferries & OSV

Regional User Analysis

- North America
- Europe
- Asia Pacific
- Rest of the World (RoW)

South America, South Asia, sub-Saharan Africa, the Middle East and North Africa: these are the regions that would greatly benefit economically from being better integrated into global value chains. More comprehensive global integration would be good for those emerging economies yet to realise the potential of global trade.

Part of the supply gap has been bridged by short-term cyclical factors such as longer travel distances, slower speeds and lower fleet efficiency (e.g. long ballasting routes) in many segments. By continuing to buy fuel-efficient vessels for already oversupplied markets, ship investors have exacerbated a deflationary cycle. The individual ship segments have been impacted differently: some can be regarded as being over the worst (Crude tankers) while others have yet to be impacted (LPG), but most, if not all, ship segments seem to be exposed. Dry bulk is approaching what could be considered the eye of the storm. The larger container segments continue to build up excessive capacity. Product tanker earnings have taken us by surprise, but market sentiment could easily turn negative again if the many new vessels currently on order are delivered.

The shipping industry remains both cyclical and volatile, but its mean reverting nature seems to have been absent for a prolonged period due to massive over ordering in many segments. Investors who have been planning to ride the global recovery are realizing that what goes down sometimes stays down for quite few years.

With regard to the vessels used, a bulk carrier can be described as a ’large single-deck ship which carries unpacked cargo. The cargo is simply poured, tipped or pumped into the holds or tanks of the ship’ (Alderton, 2004, pg 47), being a type of vessel which was created out of economic necessity for simply transporting cargo

from point A to point B. The major dry bulk cargoes carried by these vessels can be classed in five main categories:

- Iron Ore
- Coal
- Grain
- Bauxite & Alumina
- Phosphate Rock

For the successful completion of a voyage a number of factors influencing the commercial viability of a marine adventure must be taken into account, with elements as operational (fixed costs) and voyage (variable costs) being considered. Bunker fuel is almost by default considered to be the main contributor toward voyage costs, with bunkers ranging at about 78% of the daily voyage cost, compared to 28% in the 1990s (CSIW, 2012a).

2. OVERVIEW OF THE MARINE FUELS INDUSTRY

2.1 INTRODUCTION

Here in lies a review of the literature which aims at putting the work described in this project into an appropriate context for the reader. The views and opinions expressed in this review serve as material used to underpin the information presented in the chapters onwards, in a logical order.

The review focuses on providing an overview of linked material which is split into three main areas. The first area introduces the bunker market and continues to studies on the demand and supply of ship transport and the factors affecting it. Further on, views on how market sentiment has reacted to changing fuel consumption trends of bulk carriers, and how commercial activity was affected within the dry bulk cargo industry are presented. The final area addressed refers to the views expressed on fuel consumption and its affect on profitability, employability, and costs.

2.2 BUNKER FUEL MARKET

Marine fuels industry is characterized by a complex, international network of organizational and trade relationships. Marine distillates historically come from poorer-quality distillate recycle streams that are unsuitable for upgrading to diesel fuel or other low-sulfur products. Thus, the supply chain for the marine fuels industry begins with integrated petroleum refineries, where distillation unit operations are combined to form the bulk of residual fuel stocks. Dominant producers of marine fuels are divisions of the major oil companies. Around the world, these large producers are joined by hundreds of smaller firms that contract to transport, blend, and sell low-quality fuel stocks to the shipping industry.

The term "bunkering" is defined briefly as the transfer of fuel onto the ship, in containers, constructively intended for consumption and to ensure the movement of the vessel. The global bunker market is determined by the enormous and growing needs of the world’s fleet in the fuel supply of vessels for different purposes. There are currently many different specifications of marine fuels, qualitative characteristics, which are strictly regulated by national, and ISO international standards and Russia’s G.O.S.T and TU.

In consequence, actual marine fuel oil prices are depending on crude oil prices, transport costs, the local or regional supply and demand situation, political and fiscal

impacts, and -last but not least- the global economy: In boom times, more ships sail faster, and more marine fuel oil is burnt in consequence.

The final stage of the marine fuel supply chain is the bunkering itself, which can either be done while the ship is docked or directly from bunker barges while the ship is anchored. There are hundreds of bunkering ports around the world and thousands of firms that provide the actual bunkering service.

The bunker fuel market is growing due to the growing demands of fuel for tanker vessels and container ships. Large bunkering ports around the globe are Port of Fujairah and Singapore, accounting for a considerable share in the global bunker fuel market. Asia-Pacific is leading the bunker fuel market due to fact that major commodity consumption centers of the world are in the region. European bunker fuel market is growing with a considerable rate because the region has some of the busiest trading routes in the world and the region houses several choke points, evolving into major trading routes. Port of Rotterdam and the Port of Gibraltar, busy routes in the region, have urbanized into an attractive bunkering destination owing to be near to the choke points.

Bunker fuel is utilized by shipping corporations for fueling their marine fleet. Distillate fuel and residual fuel are the types of fuel used in the bunker fuel market. Residual fuel dominates the bunker fuel market among the types of fuels used with around three fourth market share.

Bunker fuel market can be categorized on the basis of fuel grades as marine gas oil or marine diesel oil (MGO/MDO), intermediate fuel oil (IFO) 380, IFO 500, low sulfur (LS) 380, IFO 180, LS 180 and IFO 700. IFO 380 and IFO 180 are the most preferred fuel grades among the fuel grade categories, owing to the cheaper cost of IFO 380 and IFO 180 as compared to other fuel grades. IFO 380 is expected to grow at a significant rate in coming years because most of the ship engines are capable of combusting IFO 380 fuel grade. As emission control areas (ECAs) are expanding, the demand for MDO and MGO is expected to increase in the coming years.

On the basis of seller of bunker fuels, the bunker fuel market can be categorized as leading independent distributors, major oil companies and small independent distributors. Some of the companies such as World Fuel Services Corporation and Chemoil Energy Limited operate in most of the major regions of the world. Lukoil-Bunker LLC and Gazpromneft Marine Bunker LLC are the companies

which operate only in some restricted regions of the world. Leading independent distributors has a major advantage over small independent distributors that they own physical assets such as blending facilities and storage terminals in major bunkering ports. Since, the leading independent distributors are much more financially stable than small independent distributors; they can easily afford to acquire such physical assets in large ports as compared to small independent distributors.

On the basis of end users, bunker fuel market can be categorized as tanker vessels, container vessels, and bulk and general cargo vessels. Bulk and general cargo vessels dominate the global bunker market. But cargo vessels require more manpower and time to carry to do loading and unloading activities as compared to container vessels, so container vessels are replacing cargo vessels from the global bunker fuel market. Due to the replacement of cargo vessels by container vessels, container vessels are expected to have a significant share in the bunker fuel market.

Some of the factors driving the growth of the bunker fuel market are rapid increase in bunker requirements in crude oil and product tankers, and increasing hydrocarbon resource development activities in offshore areas. But, there are also some factors restraining the growth of the bunker fuel market such as fuel reduction initiatives by global shipping community.

Some of the competitors in the bunker fuel market are Gazpromneft Marine Bunker LLC, Aegean Marine Petroleum Network, Inc., Lukoil-Bunker LLC, Exxon Mobil Corporation, and Chemoil Energy Limited.

2.3 VALUE OF THE BUNKER MARKET

Experts accomplished special study prospects of the world bunker market. According to these studies, the need of the world's merchant fleet in the fuel will reach by 2020 382-405 million tons a year. In more long-term until 2050 this value is projected at 402-543 million tons / year. These data were obtained on the basis of the preliminary forecast of the world's fleet growth up to 125-170,000 vessels by 2050. Then the total rated power of vessels engines of the global fleet is estimated to range from 468, 9 to 502, 2 MW by 2020 and from 657, 4 to 890, 3 MW until 2050.

For the purposes of this project, an 'economic vessel' is one which has optimized its economic performance, by utilizing its full cargo capacity and fully operating at either a cost maximization point, or a cost minimization point. Aside

from the significance bunker fuel has on the economic performance of a vessel, dry bulk shipping is facing major threats since the unpredictable complete collapse of the Baltic Dry Index (BDI) in 2008 to 663 points, the lowest since 1985 (Li, 2008, pg 35). Shipping operators must decide which strategies they will adopt individually (Li et al, 2008, pg 35). As shipping has its own cycles, which last between 3-5 or 8-10 years, no accurate reports can predict how long a shipping cycle will last. As such, the operators must manage risks speculatively (Li et al, 2008, pg 35) including the bargaining power of buyers, bargaining power of suppliers, threat from new entrants, threat from substitutes, and degree of competition.

2.4 DEMAND AND SUPPLY

There has been a plethora of research conducted with a view to explain the demand and supply factors in the dry bulk industry, and the factors that affect it. Glen (2007, pg 431) aimed at providing an overview of the main themes that have been the centre of attention of the past 15 years, when in general the competitive conditions of the industry have been taken as granted.

In general, the approach used to estimate marine bunker fuel use can be described as an "activity-based" approach with a focus on the international cargo vessels that represent the majority of fuel consumption. Components of the estimation include:

- identifying major trade routes,
- estimating volumes of cargo of various types on each route,
- identifying types of ships serving those routes and carrying those cargoes,
- characterizing types of engines used by those ships, and
- Identifying the types and estimated quantities of fuels used by those engines.

Implementing this approach involves combining information from a variety of sources: data on the existing fleet of shipping vessels from Clarksons (2011), information from Corbett and Wang (2005) and various industry sources on engine characteristics, and projections of future global trade flows from Global Insights (2005). The data on vessels and engines provide a characterization of fuel use

associated with delivering a particular load of cargo, and the data on trade flows control how many times, and over what distances, these loads have to be delivered.

Additional macroeconomic data (such as population, GDP, GDP deflators, industrial output, foreign exchange rates, and export prices by country) and geographical distances are used as exogenous variables. A quantitative modeling technique of the dry bulk market was also used in order to test for heteroscedasticity, seasonality, assumptions about expectations, and the behavior of ship prices (Glen, 2007, pg 432). The technique used identified trends in the recent literature on the topics of financial derivatives, and modeling ship price volatility rather than value. An issue having considerable implications for this approach is that of the stationary of freight rate time series (Glen, 2006, pg 443).

Lun and Quaddus (2009) provide a study where they explain how the four shipping markets affect one another by 'empirically testing the relationships among the key variables of bulk shipping – prices of ships (in new building market, second-hand market and demolition market), fleet size, freight rate, and seaborne trade.' It was shown that 'seaborne trade significantly affects fleet size, while fleet size is also affected by freight rates' (Lun and Quaddus, 2009, pg 37).

Apart from the fundamentals that drive shipping, 'the current state of world shipping markets and the surplus of tonnage have left many owners needing to accept fixtures to meet their costs' (Ashby, 2011, pg 6). An excellent example of the implications the falling shipping market has on dry bulk ship owners in affecting their profits can be seen by looking at the example of Malaysian Bulk Carriers. The company 'reported a 57% decline in operating profits for the first nine months of 2011 to $21.1 million, compared with the same period the previous year' (Leander, 2011, pg 5).

Furthermore, the time charter equivalent rate per day for Maybulk's dry bulk vessels saw a 35% decline (Leander, 2011, pg 5). This highlights the volatile nature of dry bulk cargo shipping and suggests that with such volatility that the managerial pressures involved in the business would require careful budgeting.

2.5 SENTIMENT

Lun and Quaddus (2009), state that the market is characterized by several conditions. Large numbers of firms owning bulk carriers and providing similar

services exist in the market, and entrants have easy access to information such as 'freight rates from the Baltic Exchange, and customers from brokers' (Lun and Quaddus, 2009, pg 38).

Cullinane (1995, pg 181) suggests that as the shipping market has traditionally been viewed as one with volatile cyclical fluctuations where,

> ***'the size and frequency of these fluctuations suggest that risk has a pervasive influence over the decisions that shipping companies make. Although risk and uncertainty are present whenever any decision is made, there are several factors which make the shipping industry a particularly interesting arena for analyzing.'***

The commercial risk analyzed in a portfolio analysis of market investments in dry bulk shipping with particular emphasis on market risk influence on ship owner's revenue is what Cullinane focuses on, where the risk spoken about is classified into four factors from which the two are bunker fuel price risk, and market risk as a whole (Cullinane, 1995, pg 181).

Gray (1987 cited in Cullinane, 1982) suggests that from a ship owner's perspective of risk, the most important uncertainties lie within revenue fluctuations rather than costs. However, Interviewee A notes that in the long run, the market players that benefit the most are the ones that go against market sentiment. It is thus arguable whether in order to limit risk one should focus on costs rather than focusing on revenue-based strategy. One can argue that this is reinforced by the analysis of Clarkson Shipping Intelligence (CSIW, 2008) where right before the collapse of the dry cargo market the best market to invest in was analyzed by assessing the market performance in all of the major shipping sectors, with the dry bulk sector being considered as the best alternative mainly because 'investors have made their feelings clear' at a point where record investment of $88 billion had been identified. Thus one that would have gone against the market sentiment would have benefited in the long run. Besides, in the dry bulk market 'it is only in the short run that peak profits can be realised' (Engelen et al, 2009, pg 391).

Furthermore, Cullinane bases modeling assumptions on a full employment basis for the vessels analyzed, something that can be argued as overly optimistic, when modelling periods of financial decline where vessels may be laid-up (withdrawn from commercial trading). Demand, supply, and market sentiment are directly linked with market risk, as

> ***'from the industrial organization perspective, the demand and supply conditions in the bulk shipping market can influence the market structure, which in turn affects the decisions of firms in the marketplace' (Tirole, 2003 cited in Lun and Quaddus)***

However, Li, Zhen, and Xu (2009, pg 35) in an insight into the dry bulk market through demand and supply analysis note that, that as the shipping market has its own cycles, playing a core role in shipping industries' economics, market participants are given the opportunity to manage risks speculatively. They also go on stating that the dry bulk market 'has experienced 17 cycles altogether including the current recession. Each of them was triggered by social, economic, or political events' (Li et al, 2009, pg 35). This highlights the human factor in triggering fluctuations in the trade cycle, and indicates that what triggers trade cycle alterations is above all the entrepreneurial variable of human behavior to events, which are intertwined with the perceptions of market solidarity.

Further evidence of the dry bulk market participants being highly speculative is shown in Li et al (2009). In periods of market prosperity 'ship owners cannot even sense that the crises of the shrinking demand and declining market inflict losses on them' as the entering into the market of newly built vessels 'are speculative orders with no firm charters in place' (Li et al, 2009, pg 39). This can be attributed to the nature of shipping companies, where they

> ***'may believe that it is a golden time to invest for vessel new buildings when cost is low. Individually it is a sensible idea, but if it is followed by numerous imitative competitors, the situation is totally another case. The shipping market will miss its boom when heavy deliveries of vessels continue to bring the freight rate down***.'

Clarkson's, (2012a) covering a demand and supply analysis of 2011, concluded that great demand was spoiled by too much supply, where, despite the Euro crisis dry cargo demand grew by 7%, bulk carrier supply grew by 14% of the fleet, causing earnings to fall by 30-40%.

The dry bulk market experienced a troublesome 2015 as the ongoing decline in Chinese coal imports was not countered by any significant upswing elsewhere. Whereas iron ore imports were on a par with 2014, steel export from China reached a

new high, benefitting mid-sized ships. For 2016, much depends on what Chinese steel mills will do. Will they continue production above domestic consumption – or substitute domestically mined ore with imported ore? The jury is still out. At the end of November, 2015, the Baltic Dry Index hit 498, a new all-time low. For most of the year, the majority of ships have traded below OPEX levels, resulting in financial losses for many companies.

The horrific first half of 2015 brought around a new half-year record for scrapping. Improvements in the freight market during Q3 regrettably cooled down demolition market activities. Nevertheless, fleet growth recorded a twelve-year low.

In 2016, BIMCO expects the supply-side to grow by around 2% (2.6% in 2015E) – and that this will be helped by a new record level of scrapping. On the demand-side, growth is forecast to remain level. Challenging market conditions in China will be likely to affect the level of risk.

2.6 BUNKER FUEL COSTS

Apart from revenues, lowering shipping costs is another important aspect that ship owners aim for' (Chen et al, 2010, pg 307). This is one of the reasons fuel consumption can be considered as vital for a bulk carrier. Fuel costs fall under voyage costs and are the group's prime cost factor. Besides voyage costs, vessels also incur capital costs, and operating costs. Voyage costs are the most variable, as fuel price and fuel consumption rate can differ significantly between different vessels compared to other voyage costs (Chen et al, 2010, pg 308).

It should be noted that Alizadeh, Kavussanos, and Menachof further support that fuel is of a major concern by mentioning that 'bunker fuel is one of the major operating expenses of any shipowner, accounting for almost 50% of voyage costs' (Alizadeh et al, 2004, pg 1337). In addition, they go on mentioning that 'as recent events have shown, bunker prices have a major impact on the operating profits in the industry' (Alizadeh et al, 2004, pg 1337).

Recent evidence of this effect and the dramatic impact it has had on ship owners' profitability has amplified the matter significantly as:

> ***'In the 1990's fuel was only 28% of the daily voyage cost (i.e. hire + fuel) but it is now 78%. Put another way, ship hire used to cost twice as much as the fuel, but today fuel costs twice as much as the ship' (CSIW, 2012a)***

Changes in the price of fuel affect the relative cost structure. If it rises, fuel and vessel running costs increase and the relative share of fuel costs as a component of day-to-day costs also goes up. It should be noted with regard to vessel costs that the fuel costs contained in them have been calculated in general with reference to the vessel's engine power. In reality, vessels with the same engine power can consume very different amounts of fuel. The speeds of vessels also affect consumption, which has an impact on fuel costs: consumption at lower speeds is less, and fuel costs are also lower as a result. But vessels on scheduled routes cannot normally reduce their speed without it affecting the viability of the entire transport chain.

Energy prices were projected to fall by 42% in 2015, largely reflecting a 45% drop in crude oil prices, which are still estimated to average USD 53 per barrel, according to the World Bank. Most of this decline has already occurred, implying flat oil prices for the rest of the year as the industry reduces the current large supply overhang. The weakness in crude oil prices will extend to other energy markets, especially natural gas in Europe and Asia. The European natural gas and the Japanese liquefied natural gas (LNG) price benchmarks are projected to decline by 15% and 30%, respectively, in 2015. Coal prices have fallen 40% since 2011 and are projected to decline by an additional 12% in 2016 due to weak Chinese import demand and a global supply surplus.

Lastly it is important to note that a vessel's charter party contract determines who pays for the fuel it uses (Table 2.6.1). If the vessel is in the service of the shipping company that owns it, the shipping company pays all the costs, including fuel. A shipping company that has entered into in a time charter agreement leases the vessel to a charterer at a certain price for a given period of time. The time charterer pays the operational costs of the service, including fuel costs and the shipping company pays the day-to-day running costs. A voyage charter agreement concerns the transportation of cargo from a port of loading to a port of discharge, and in this case the shipping company pays not just the day-to-day running costs but also the transportation costs, including fuel. With a bareboat charter agreement, the shipping company is only responsible for the vessel's capital outlay as well as certain insurance

premiums, and all other costs are the responsibility of the charterer (Karhunen et al 2004.)

Table 2.6.1: Responsibility for Fuel Costs in Charter Agreements

Charter agreement type Responsible for fuel costs
Time charter Charterer
Voyage charter Shipping Company
Bareboat charter agreement (vessel hire)
Charterer

2.7 SUMMARY

The crucial question for the company, in order to efficiently organize its refueling, remains the cost of fuel at the moment it will need, given the increased volatility of the price of marine fuels. As detailed in this part of this thesis, a detailed inventory of risks is required to be addressed by shipping companies in their business activities. One of the main risks that greatly affects the company's profitability are changes in the prices of marine fuels, which are unpredictable and in turn contribute to the volatility and uncertainty of the cash flow and operational profitability of shipping companies.

To address this significant risk, modern derivative financial products have been developed to protect shipping companies from unpredictable changes in the prices of marine fuels, which may prove to be disastrous even for its very existence and stabilize extraordinary circumstances, but also to maintain its competitiveness by adding value and ensuring stable (known in advance) operating costs for fuels. Shipping companies should now understand that the need to formulate a risk hedging strategy is a process that requires careful planning to meet the specialized needs and the risk to which each company is exposed by selecting the appropriate portfolio. To sum up, the shipping industry faces many challenges and is geared towards increasing efficiency and reducing costs in order to remain competitive.

Effective supply of marine fuels and the implementation of an integrated risk management strategy are now indispensable to meet these goals and to ensure their sustainability in a highly competitive and volatile economic environment.

3. DRY BULK SHIPPING SECTOR

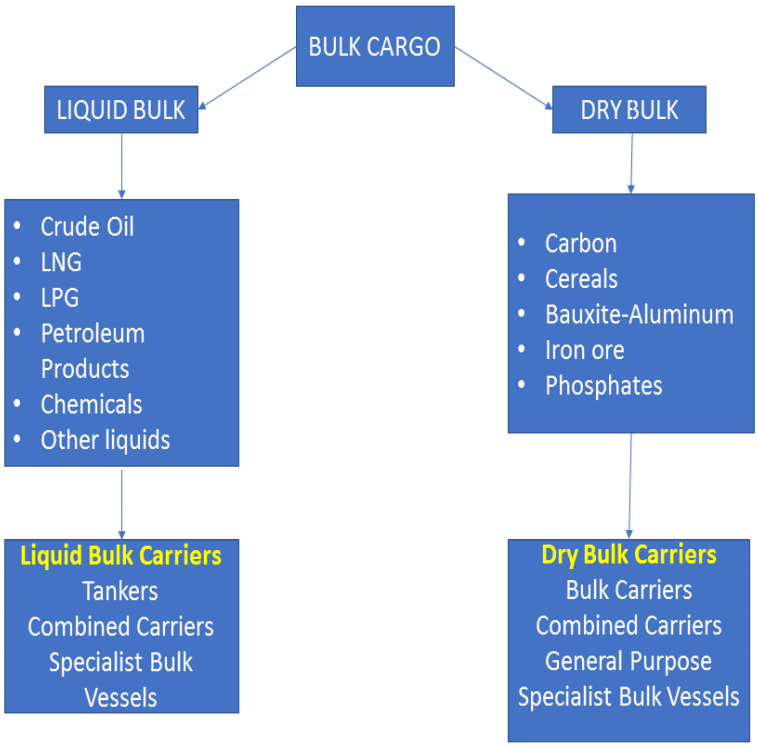
3.1 TRADE AND CARGO CHARACTERISTICS

The maritime transport of dry bulk belongs primarily to tramp shipping. At this point, it would be useful to determine what exactly is a bulk dry load. The term "bulk cargo" is used to describe a large number of loads such as crude oil and its derivatives, LNG, LPG, coal, iron ore, cereals, cement, salt and much more. The bulk distinction can be distinguished from the rest by two definitions in which two different aspects are included. The first definition focuses on the physical characteristics and handling of specific loads while the latter defines the economic and technical aspects of their transport, which is organized and planned on the basis of the large volume to be transported.

Under the first definition, bulk cargoes are those which are characterized by physical homogeneity in composition and geometry, which allows management and transportation as bulk. While the second is considered to be any cargo that is large enough to occupy the capacity of an entire ship or a hold (Stopford, 2013). In the context of a financial analysis of a shipment, the second definition is adopted and bulk cargo is defined as "any cargo carried by sea in large batches with a view to reducing unit transport cost". Reconciliation of the two above concepts can give a clear picture of the bulk load, since both the above definitions highlight and complement the different aspects of the particular loads.

Of course, under the upper prism, and mainly on the second view, bulk cargoes can also be considered as goods such as frozen meat, vehicles (mainly cars), steel products, precast concrete sections and others. In order not to be confused, loads of this type are referred to as 'Special Bulk Loads'. At a second level of separation the bulk cargoes are separated into 'Liquid Bulk Loads' and 'Dry Bulk Loads'. Differentiation, as easily understood, lies in the physical composition of loads. This paper focuses on dry bulk cargoes and for this reason a more detailed reference is made below. The following figure shows the separation of bulk cargoes.

Figure 3.1.1 Categories of bulk cargo and transport ships



Source: Stopford (2013)

On the contrary, loads whose quantities are insufficient to "fill" an entire ship or a hold and which are united in some form (container, pallet, special bag, etc.), they are part of the general cargo category. For example, high-value products (electronics) or fragile products (fruits and vegetables, wine, beverages, etc.) can be traced to commodities whose quantities are large but their characteristics do not allow their handling and transport as bulk.

Bulk dry cargoes that are transported by sea are divided into two major categories:

The five (5) main bulk dry loads:

1. Iron ore
2. Carbon
3. Grains

4. Bauxite -alumina
5. Phosphate rock

The secondary bulk dry loads. This group of loads includes a series of processed and semi-processed materials transported by sea, of which the main ones are:

1. Steel products
2. Cement
3. Aluminum Products
4. Sugar
5. Salt
6. Wood chips
7. Sulfur
8. Fertilizer
9. Various minerals and others

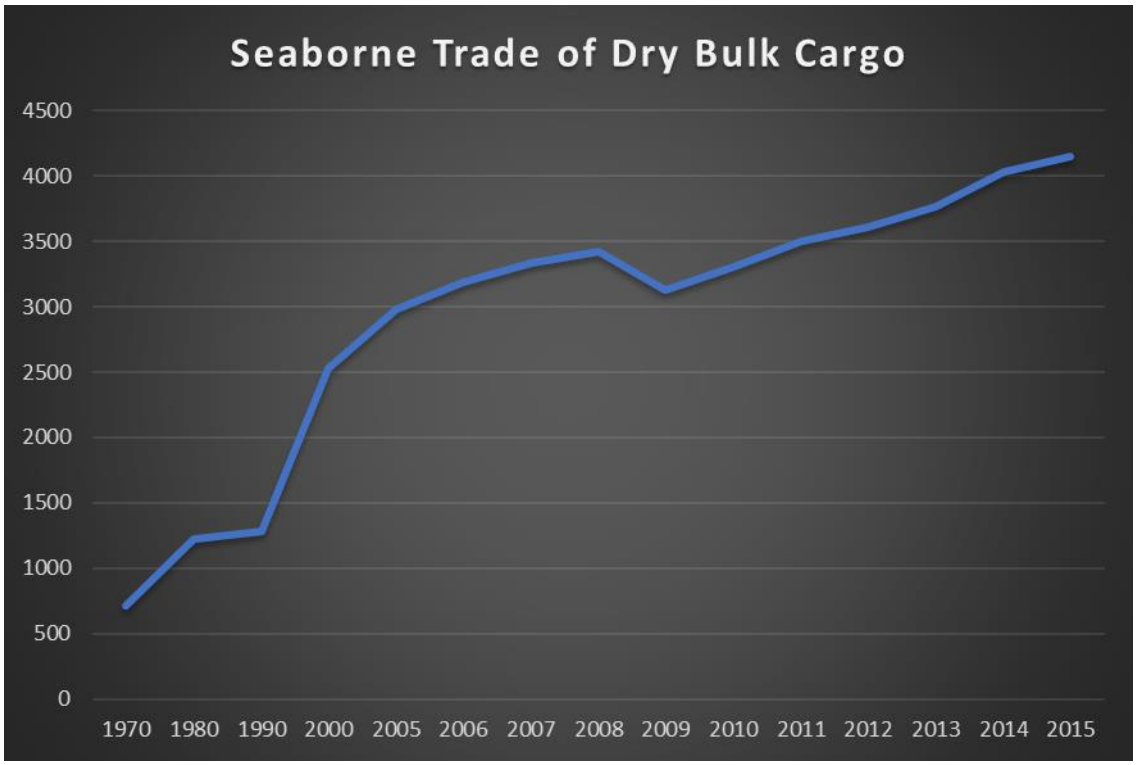
The main characteristics of the above loads are the fact that they are primary products or semi-finished products, which are transported in very large quantities, either as raw materials or semi-finished, they are considered to be products of low economic value (per unit of load). That is precisely why transport is carried out in the most economical way, which is the sea transport. The reason why shipping for this type of cargo and such quantities is the most economical than the others (road, rail, air) is analyzed below.

Dry bulk carriers play an important role in linking sources of dry bulk to their recipients (power plants, steel, food processors, etc.). Due to the increasing need to supply goods and changes in the pattern of global demand for different raw materials, maritime transport is the most cost-effective way of integrating the supply chain with other modes of transport, such as by air, rail or road. Shipping benefits from other modes of transport due to the large economies of scale generated by the large size of

the ships used and also by the ability of serving destinations with limited existing infrastructure. In addition, the main supply centers are scattered across the globe, including large water distances. Thus, in some cases, sea transport is the only possible transport that can be carried out (Review of Maritime Transport, 2016).

In the years since 1980, dry bulk trade has a growing trend. This trend, of course, is determined by the world economy itself as well as by developments and events that in turn affect it. The graph below shows the increasing trend of international maritime trade as well as certain events which have admittedly affected the movement of dry bulk goods.

Figure 3.1.2 Developments in international seaborne trade of Main bulk commodities (iron ore, coal, grain, bauxite and alumina and phosphate rock)



Source: Review of Maritime Transport (2016)

As far as the pattern of trade is concerned, China has emerged as a major importer of mainly coal and iron ore for the production of steel and energy, bringing it to the world's largest producer of steel, accounting for more than 50% of world production (Niklas Bengtsson Lloyd's Register - Fairplay Research), this remains stable over time.

3.2 BULK CARRIERS

Bulk carriers are vessels specially designed for the transport of dry bulk cargo, in large quantities and in bulk, not unified or packaged. Such loads, as mentioned above, are coal, iron ore, cereals, cement, steel products, sugar, salt and much more. The first specialized vessel to carry this kind of cargo was built in 1852, it was the British vessel for coal transport named SS John Bowes. Since then, the market itself and the (global) needs for this type of cargo have prompted the rapid growth of this type of vessel, leading to an increase in the size and level of its technological equipment.

Figure 3.2.1 Different types of bulk carriers

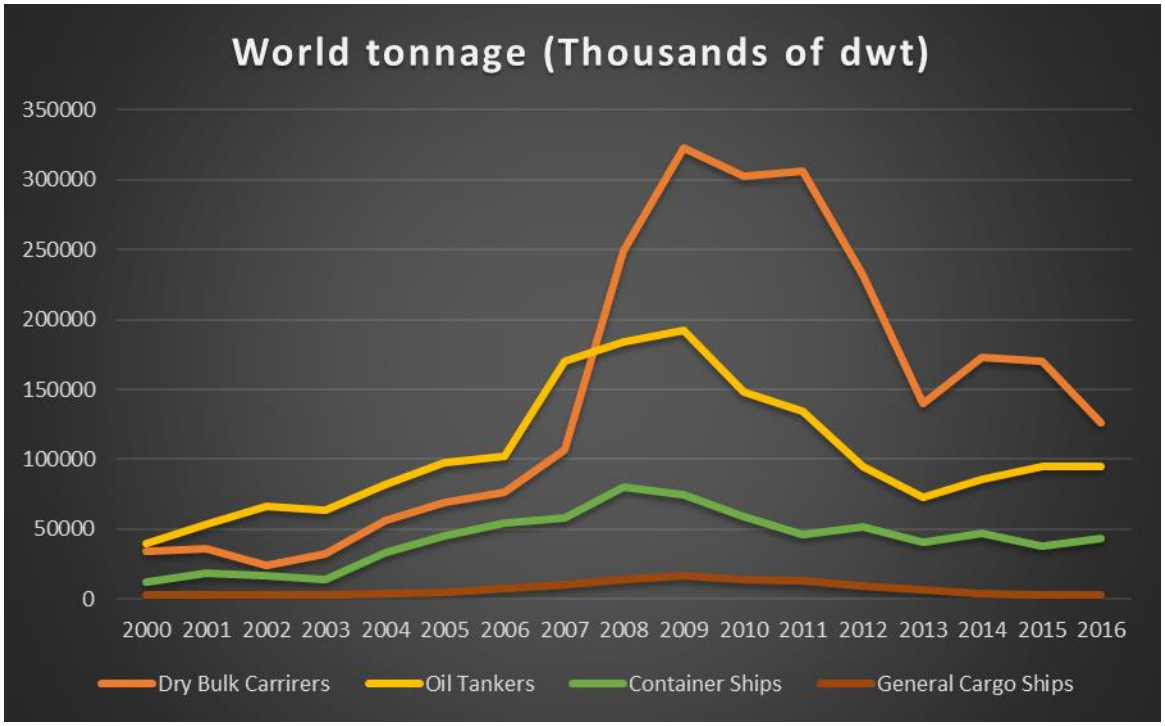
Source: http://www.naftikachronika.gr/ **(2017)**

Current bulk carriers are specially designed to maximize their capacity, combined with other factors, such as safety and efficiency when transporting a large variety of dry bulk loads. It has to be noted that over time the way of their construction has been differentiated by assimilating technological developments in optimizing the metal structure (reducing the weight of metal construction using high strength steel and applying modern computational resistance methods) resulting in lower manufacturing costs, increase in capacity but also the reduction in the economic life of ships which is negative for the shipowners. The latest developments are

affected by the recent international safety regulations (IMO), which may necessarily lead to new constructions in double hull designs.

The size of the world's merchant fleet over time has increased sharply and shows trends for further growth. This feature is strongly located in the bulk dry bulk sector. In the diagram below, it is clear that the average steady increase in the size of ships, and in particular bulk dry cargo shipping, from 2000 to 2016. A steep slope can be observed after 2011, where the tonnage was enormous, so shipowners had the option of dismantling their vessels in order to minimize the tonnage.

Figure 3.2.2 The change in the size of various types of vessels



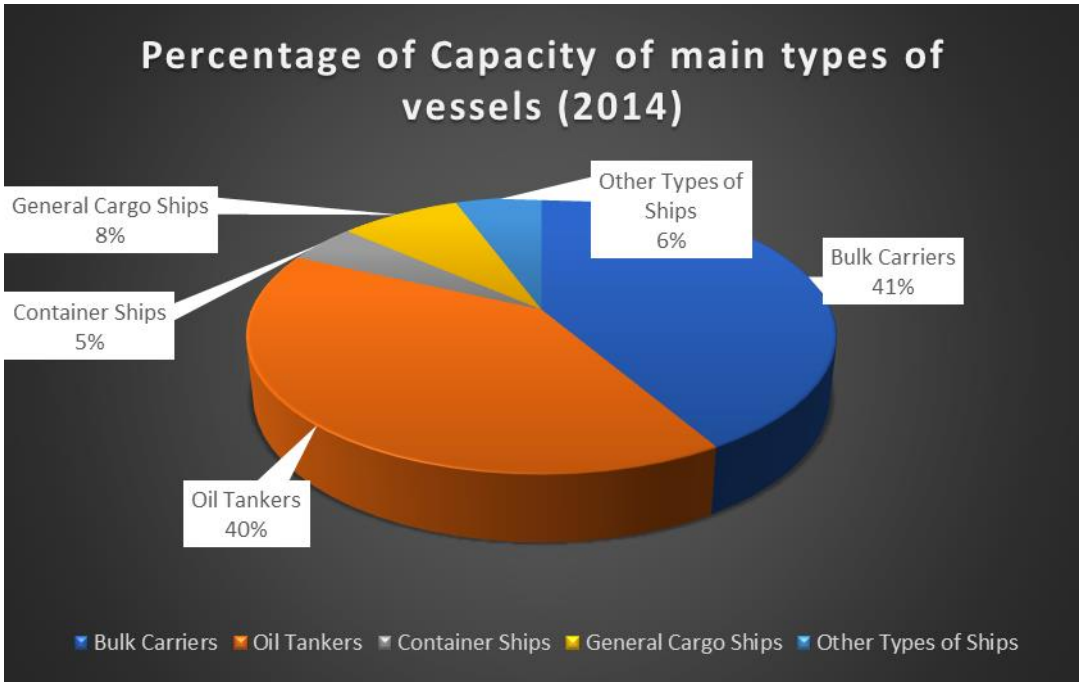
Source: Review of Maritime Transport (2016)

Based on recent data from the Institute of Shipping Economics and Logistics (end 2010 - early 2011), the fleet of bulk carriers is the largest in relation to commercial fleets of other categories, such as:

- The liquid bulk carriers (Tankers)
- The container ship fleet (Containerships)
- The fleet of General cargo ships

- Passenger / Cargo passenger ship fleet.

Figure 3.2.3 Percentage of Capacity of main types of vessels



Source: Review of Maritime Transport (2014)

The share of bulk carriers in the world's capacity offer is 41%. This percentage is the result of entering the ship market with a total new capacity of 646 thousands dwt in 2014.

3.3 BULK CARRIERS CLASSES

This type of ships, depending on their size and capacity, are classified in specific classes. As for classes, there seems to be confusion in defining. Apart from the five main categories, whose boundaries vary both over time and by those involved in this market (agencies, institutes, specialized, and others), depending on the view from which they observe, some new subcategories have emerged within these basic ones. In general, the limits of the classes of ships, due to various factors such as the nature of cargo, the rapid increase in size and the technological level of ships, the demand for large quantities of cargo, the sizes of canals and others, change in time. For example, a ship at the current time considered Supramax class, was previously categorized as Panamax.

The following categorized results from a combination of both the five main categories and categories as presented in the latest Lloyd's List Intelligence: Global Dry Bulk Fleet Analyzer, June 2015, and some edited by the author.
The categories are:

- Small vessels: <10,000 dwt
- Handy: 10,000 - 24,999 dwt
- Large Handy: 25,000 - 39,999 dwt
- Handymax: 40,000 - 49,999 dwt
- Supramax: 50,000 - 59,999 dwt
- The Panamax: 60,000 dwt - 84,999 dwt (although a new categorization based on Lloyds List Intelligence extends the Panamax limit to a category of Post Panamax - up to 100,000 dwt. However, the limits will remain in this categorization.)
- Capesize: 85.000 dwt - 199.999 dwt
- VLOC (Very Large Ore Carriers)> 200,000 dwt

Handy, Large Handy vessels are the widest category of Handysize (10,000 - 39,999 dwt), while vessels of this category, along with those of the Handymax and Supramax categories, are part of the Handies general category. Small vessels belong to the class of vessels with a capacity of less than 10,000 dwt. They usually carry loads from 500 to 2,500 tonnes, they have one hold, and they are designed primarily for river transport. They are often constructed to be able to pass under bridges and have small crews of three to eight people. Handysize (Handy and Large Handy) ships are mainly employed in the transport of secondary bulk dry loads. Vessels of this class operate at regional transport rather than in transatlantic trips (for example in the Eastern Mediterranean and Black Sea region or in the Gulf of Mexico region and others), taking part in the cargo transshipment process, serving as feeder ships, for larger ships.

The Handysize vessels are suitable for small ports with restrictions both in length and in depth. The cargo handling equipment they have in place allows this class of vessels to serve ports which do not have the appropriate loading / unloading equipment. Handymax and Supramax ships operate on a dispersed geographic number of international routes, mainly transporting iron ore, coal, grain and secondary bulk dry cargoes. Specifically, Supramax vessels (50,000 - 59,999 dwt) usually have suitable cargo handling equipment, while their capacity tends to compete with that of Panamax.

The dimensions of these vessels allow, given the scope and the quantities they carry, to allow servicing smaller vessels that have limitations on the length and draft of the ship in relation to Panamax vessels. Therefore, Soupramax vessels have greater profitability than a typical Handymax of 45,000 dwt. Panamax vessels have maximum dimensions of 290 m in length, 32.2 m in width and 12.04 m in draft, these are the maximum dimensions for Panama Canal, so they can pass, making them more flexible than the larger vessels. They mainly transport coal, cereals and, to a lesser extent, secondary bulk dry loads, mainly steel products, forest products and fertilizers.

As mentioned above, there is a class of bulk carriers that falls within the Capesize limits, but in the last years it has started to stand out and now it is a major category, mainly due to the evolution of bulk dry bulk demand and trade. This is the Post-Panamax category (85,000 - 99,999 dwt). Vessels of this category tend to be larger in depth and length than the typical Panamax vessels, having a larger capacity. They are designed to ship large quantities of cargo to ports with depth restrictions. This class of vessels cannot pass through the Panama Canal.

Capesize vessels are mainly specialized in the transport of two cargoes, iron ore and coal, and some more rarely transport large grain lots, mainly on long haul routes. For this reason, the steel industry plays a very important role in the market for Capesize ships. Due to their size, there is a comparatively small number of ports around the world which have the necessary infrastructure to accommodate this type of vessel.

Table 3.3.1 Type of cargo carried by ship class

Dry Bulk Cargo Type	Handysize	Handymax	Supramax	Panamax	Post Panamax	Capesize	VLOC
Iron ore	X					X	X
Carbon	X		X	X	X	X	X
Cereals	X	X	X	X	X		
Alumina - Bauxite	X	X	X	X	X		
Phosphate	X	X	X				
Steel Products	X	X	X	X	X		
Wood Products	X	X	X				
Fertilizer	X	X	X				
Minerals	X	X	X				

Source: Commodity Special Feature (2016)

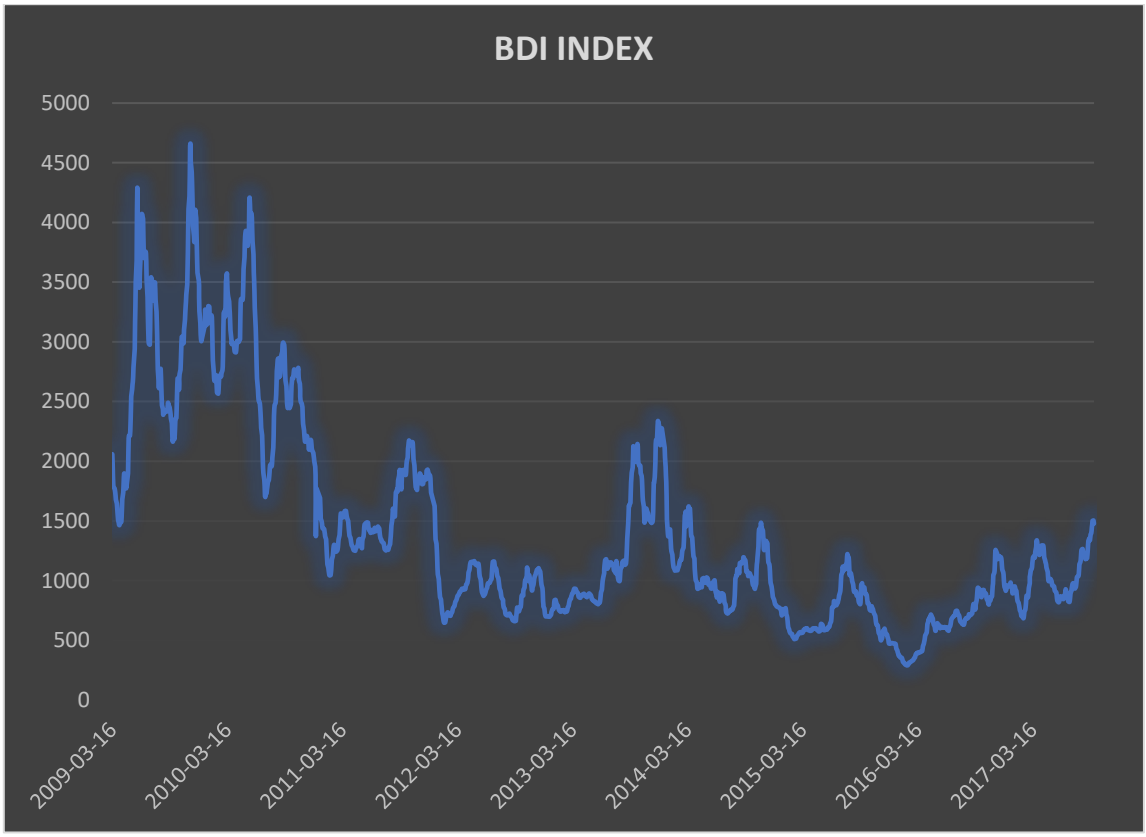
VLOC -very large ore carriers - are very large vessels, mainly serving the transportation of iron ore on long-distance routes, exploiting economies of scale developed by the enormous capacity they have.

Yet another class of ships, which mainly refer to bulk shipments (dry and wet), and therefore cannot be clearly identified either in one category or another, is OBO (Ore - Bulk - Oil), which are specially designed to carry either bulk liquids or dry bulk loads, in order to eliminate empty return journeys. The following table summarizes an indicative depiction of cargoes carried by ship size class.

3.4 THE BALTIC DRY INDEX (BDI)

The BDI index, as well as all indices, is the use of the index as a financial instrument to monitor the conditions and trends of the freight market. In fact, the index measures demand and supply directly.

Figure 3.4.1 Baltic dry index prices related to bulk dry cargo shipping from 2009 to 2017.



Source: Bloomberg (2017)

The index is a component of three other indices:

Baltic Handy Index (BHI)

Baltic Panamax Index (BPI)

Baltic Capesize Index (BCI)

BDI receives daily prices by providing a valuation of the freight rates of the main raw materials. This way the shipping agents daily estimate the freight rates in different routes and the time of delivery. Thus, the performance of the BDI reflects the conditions of

bulk dry cargo trade. Low value of BDI means a downward trend in bulk dry cargo traffic, while high value, means high mobility in the transport of specific loads. The index also functions as a "maker" of the freight market in a type of futures contract called Freight Forward Agreements (FFAs).

3.5 DEMAND FOR MARITIME TRANSPORT IN DRY BULK SECTOR

Demand for maritime transport capacity is a derivative demand because it depends on the manifestation of a desire to transport goods, which in turn stems from the global economy and international trade. Yet another characteristic of demand is the instability that it presents and which derives mainly from its character as a derivative. While third feature is the collectivity which characterizes it. Which means that the demand for one or a group of products is not just about the specific load but more like loads in any form. Regarding demand, while demand for transport increases, freight rates are rising because of the finite capacity of each ship class and at the same time increasing the value of vessels. This of course is true vice versa. Reducing that demand has a direct impact on freight rates and to the worthy resale of ships.

The most appropriate size for expressing the demand for tonnage for sea transport is the ton-mile. It is calculated by the product of the metric tons transported over the total distance in nautical miles. The use of ton-mile as a unit of measurement of demand is technically more correct than the deadweight tonnage of a ship, because it cannot be used to record the profitability of the ship's class used to transport each time. The deadweight (dwt) is primarily used to capture the capacity offer.

The demand for tonnage for sea transport is a dynamic size and, as logically, it is influenced by a number of factors. The most important of which are:

1. The global economy
2. The maritime commodity trades
3. The average sea-port distance

4. Exogenous factors

5. Transport costs

The global economy

The global economy is undoubtedly the most important factor in demand for capacity. Economic activity is aimed at the production, distribution and exchange of goods and services. An integral part of achieving the goals of economic activity in all goods produced, in the markets of the world in which demand is manifested. There is, therefore, a close relationship between the world economy and the maritime trade, since the former produces demand for maritime transport either on the import of raw materials or on the trade of industrial or semi-finished products.

The 4/5 (or 90%, extensively reported) of international trade is transported by sea. This is because:

a) The very natural configuration of our planet favors - enforcing the use of maritime transport

b) Maritime transport, historically, was far ahead of other modes of transport

c) Through maritime transport, it is virtually and economically possible to transport goods from port to port.

International trade in the world economy has now become an economic mechanism, the smooth operation of which depends largely on the economic life of the nations. As a simplified definition, it can be said that international trade is the exchange of goods and services between countries. Through which countries are given the opportunity to acquire some goods and services more cheaply than they could themselves produce for themselves and also the ability to consume goods and services that cannot be obtained from domestic suppliers.

The smooth and efficient operation of the maritime transport industry depends essentially on two key factors:

a) the shipping industry as a single market

b) the prospects and developments of the international economy, on the basis of which goods needs can be expressed, which in turn lead to increased demand for sea transport capacity.

Cyclicality of shipping follows the cycles of the global economy and productivity, which are among the most important factors affecting the demand for maritime transport. Nevertheless, the relationship between maritime trade and global industry (which is the one that will "give birth" to transport needs) is neither straightforward nor direct. Indeed, long-term demand for capacity follows the developments in maritime trade with a time lag. As a result, it is logical for carriers to have a limited ability to influence the demand for transport, which should be noted that it is directly related to the existence of an appropriate infrastructure and is developed when there are suitable and quality transport links.

The relationship between the world economy and the demand for tonnage for sea transport, it is worth pointing out that three aspects of the first one are likely to cause changes in the latter and which are:

The global economic cycle. The economic cycle sets the foundations for business circles. Fluctuations in the (global) rate of economic growth are translated and reflected through maritime trade, thus creating circular patterns of demand for capacity.

The elasticity of trade (in terms of world economy and production by extension). This is the long-term relationship between maritime trade and the world economy. Trade elasticity is the percentage change in maritime trade in the percentage change in industrial production. Observing the value of the elasticity index, one can deduce the conclusion of a growth rate of one size relative to each other and how much.

For example, for the period 1963-1996, the trade elasticity index was positive, with an average of 1.4, which means that maritime trade grew 40% faster than global industrial output. Note that world industrial production is related to the global economy.

The commercial cycle. Following the shipping cycle (with a time lag), there are cyclical fluctuations in the maritime market through the manifest demand for maritime transport.

The global economic cycles, which naturally affect world trade, do not allow the smooth development of demand for maritime transport capacity. This demand is more like a sequence of periods of high and low growth of peaks and controversies of the global economy.

Since the end of the Second World War, there has been a rapid growth in international trade, which has caused strong changes in demand for ship capacity. Changes that are reflected both by the sharp change in the trade elasticity index and the discontinuity in the relationship between world trade and global industrial production, due to the emergence of new economies and industrial forces on the world map, such as Japan, South Korea, Thailand, Taiwan and later Latin American countries.

All of these countries have expressed an increasing rate of raw materials needed to feed their rapidly growing industries. More recent examples are China and India. Last but not least, the parallel population explosion in some countries has also played a role, which has led to the need for a massive increase in imports of cereals and raw materials and hence the demand for tonnage for sea transport.

The maritime commodity trade

The impact of maritime transport of commercial goods is distinguished in the short and long term. The most important factor of volatility in demand over the short term is seasonality as well as storage. Many agricultural commodities, for example cereals, sugar, soy beans and others, are subject to the seasonality that comes from harvesting them. Seasonality has a disproportionate impact on the spot market. The transport of seasonal agricultural products is difficult to design and organize precisely, which is why the charterers are looking for the required transport capacity in the spot market.

It can be noticed that cereal market fluctuations have a greater effect on capacity charging than on goods such as iron ore, which requires a high capacity, and its shipment is secured through time charter parties in the long run (the price of chartering in the spot market is higher than in time charter). As far as the long-term trends of trade in goods are concerned, they can be identified through the economic characteristics of the industries that produce and consume the comparable goods. Although the global economy is the driving

force behind maritime trade, specific commodities may follow a different pattern from the trend of the global economy as a whole.

Just as mentioned, it is necessary to study trade at the level of industries - individual markets. This differentiation from the whole trade can happen due to change:

a) in demand for a good

b) in the sources of supply of the specific commodity

c) of the location of the production unit

d) of the consignor's civil transport

A classic example is trade in oil derivatives during the 1960s, which grew by two to three times faster than the economic index as the economies of Japan and Western Europe changed their main energy source from coal to oil. This is reflected in the diagram below.

The average distance covered by sea

Another factor affecting demand for tonnage for sea transport is the average distance that ships cover to transport the goods by sea. The longer the distance, the longer the transfer time is, and the more and the greater the means of transport required to meet the transport of a particular demand. The effect of distance on the movement of a commodity is referred to as the "average haul" of the commodity trade. The average distance is taken into account in order to capture the demand for tonnage for sea transport, expressed in tons/mile, which, as mentioned above, equals the product of the cargo carrying capacity of the good dispatched over the distance traveled (in the present case) required to be transported.

A typical example showing the immediate impact of the distance to capacity demand is the closure of the Suez Canal. This has happened two times so far. As a result, ships have to sail from the Cape of Good Hope (bypass of Africa) for routes from Asia and the Arabian Gulf to Europe and vice versa, dramatically increasing the average distances, from 6,000 nautical miles to 11,000, and thus extending its time of delivery. As a result of this situation, there has been a rapid increase in demand for ships and the general boom of the market, which translates into an increase in the price of freight rates, an increase in the

value of ships, investments, etc. The above increase in average distance means respectively an increase in the required tonnage.

Generally, when there is a rise in the required tonnage, it means that to meet this increase in demand, either increasing the frequency of ships by increasing their number or increasing the capacity of these ships is necessary. The geographic distribution of natural resource sources plays a major role in shaping this factor, as well as the geographical distribution of industrial potential and new developments and trends in production and consumption. The reasons for changing the average distance of a commodity trade are generally complex to analyze, however, the main factor determining their price is the balance between medium and long-distance suppliers arising from the abovementioned geographical distribution of production and consumption units.

Exogenous factors

Exogenous factors are mainly unpredictable and accidental events, such as natural disasters and extreme weather conditions, for example the rainfall in northern Australia (December 2010 to January 2011), which caused flooding within the country, resulting in the sealing of mines and the destruction of a large part of the road and especially of the railway network, resulting in goods such as coal and grain being unable to be transferred to the ports, so ships remain unemployed, without generating profit for companies. Exogenous factors may be of a political, social and economic nature, positively or negatively affecting the demand for maritime transport capacity and causing positive or negative variations in freight rates each time.

As far as political events are concerned, their main characteristic is the formation of an unexpected and sudden change in the demand of the maritime market. Such events are a war (between nations or a civilian), a revolution or even a regimentation of foreign property. In summary, some of these examples in the last 61 years are: The Korean War (1950), the Suez Crisis, and the Egyptian Government Canalization (1956), the six-day war between Israel and Egypt (1967), closure of oil pipeline between Saudi Arabia and the Mediterranean (1970), nationalization of Liberian oil ownership (1973), Yom Kippur war (1973), Iran revolution (1979)), the Falklands War (1982), the Cuban crisis (1960), the war

Iran - Iraq (1982), the Gulf War (199th), the attacks in Iraq from America (2003), the revolt of the peoples of North Africa (2011).

Another very important exogenous factor, which has been on the rise in recent years, is the piracy of merchant ships, mainly in the sea area off Somalia, Indochina and Guinea Bay. Beyond the obvious effects of this particular factor, its intense excitement has affected shipping routes to avoid occupation, changing thereby the average distance of each trade good. In general, events like the above do not have a direct impact on the demand for tonnage for sea transport but indirect. Nevertheless, the importance of this factor is important as a factor in the volatile behavior of ship capacity demand. However, since the manifestation of these factors cannot, in most cases, be predictable, a few forecasts are taken into account.

Maritime Transport Costs

Developments in maritime trade depend, in addition to what has been mentioned above, on maritime transport costs. This includes the initial capital invested and intended to be used for the transport of commercial goods, or the cost of capital, which varies according to whether the funds are own or a loan has been received. In addition, there is the cost of the flag. It is worth mentioning that many shipping companies use so-called "flags of convenience" to reduce wider transport costs. On the basis of this, the state in which the ship is registered does not oblige the company to hire a specific crew (reduced crew cost - operating costs to transport transnational loads).

Another significant cost is operating costs. This is analyzed in:

a) Cost of crews

b) Insurance costs

c) Cost of fuels and lubricants

d) Management costs

e) Maintenance costs

f) Cost of supplies - spare parts

Transport of raw materials and general goods by a shipping company will take place, only if the operating cost of a ship reaches a permissible limit (under normal market conditions, cost price to generate a profit), either an important benefit is achieved by the quality of the product itself. In this case, the cost to companies is the voyage costs that a vessel is charged in order to make a particular trip. The voyage costs include the proportion of annual operating costs for travel days as well as the proportion of annual capital cost for travel days. The factors that affect travel costs are:

a) Fuel costs

b) Costs of ports, tugs and pilots

c) Canal fees

d) Cost of cargo handling

e) Additional insurance costs

Generally, most of the voyage costs are on fuel, which may range from 10% to 60%. It depends on the type of vessel and the type of employment. Over the last century, improved efficiency, greater vessel size and more effective maritime shipping design have contributed to reducing voyage costs and increasing service delivery, making maritime transport even more competitive than other modes of transport, thus contributing to increasing demand for ship capacity.

3.6 CHARASTERISTICS OF DRY BULK CARGO

The five main types of dry bulk cargo

Coal

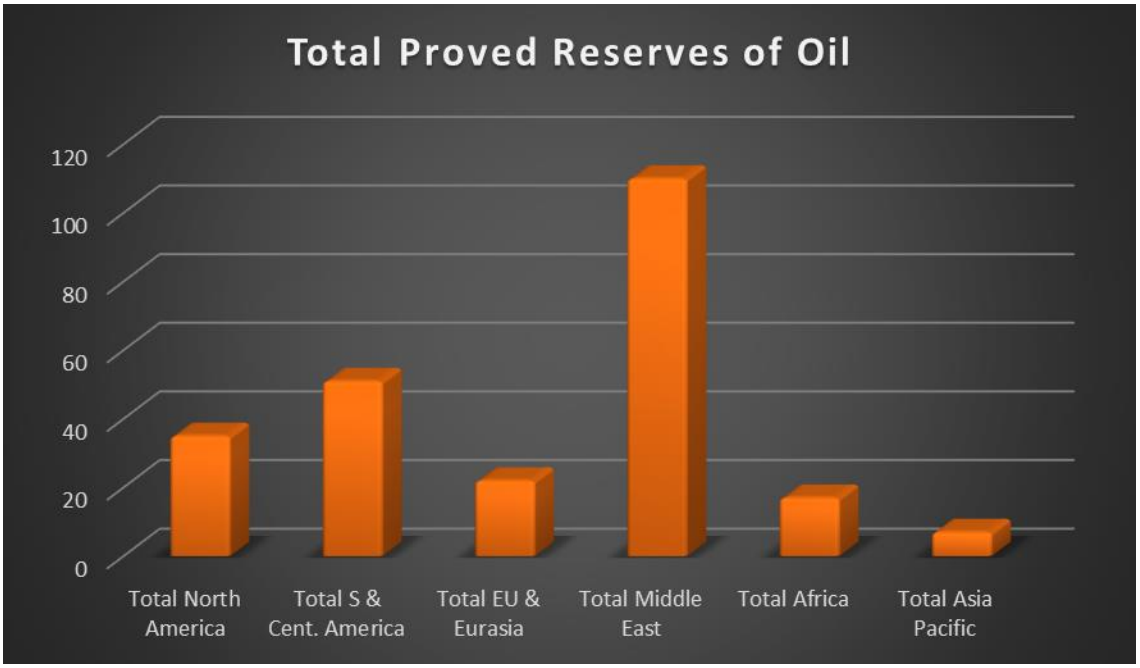
Coal is one of the most important elements to be found at present in abundance in nature. The uses of coal are many and important for the development of economies and spaces. The necessity of coal as a raw material is world-wide. Coal is primarily used in the

production of power and heat, in sheet metal during the preparation of steel, in the manufacture of cement, and as the liquid fuel. The first two uses are the most basic and require very large amounts of coal. For this reason, and specifically looking at coal as cargo transported by sea, they are divided into two main categories, which essentially consist of two different markets:

a) The purchase of 'steam coal' used in the production of heat energy

b) The purchase of 'coking coal' where it is used as a basic component for the manufacture of steel.

Figure 3.6.1 Total proved reserves of oil in 2016 (Thousand million tonnes)



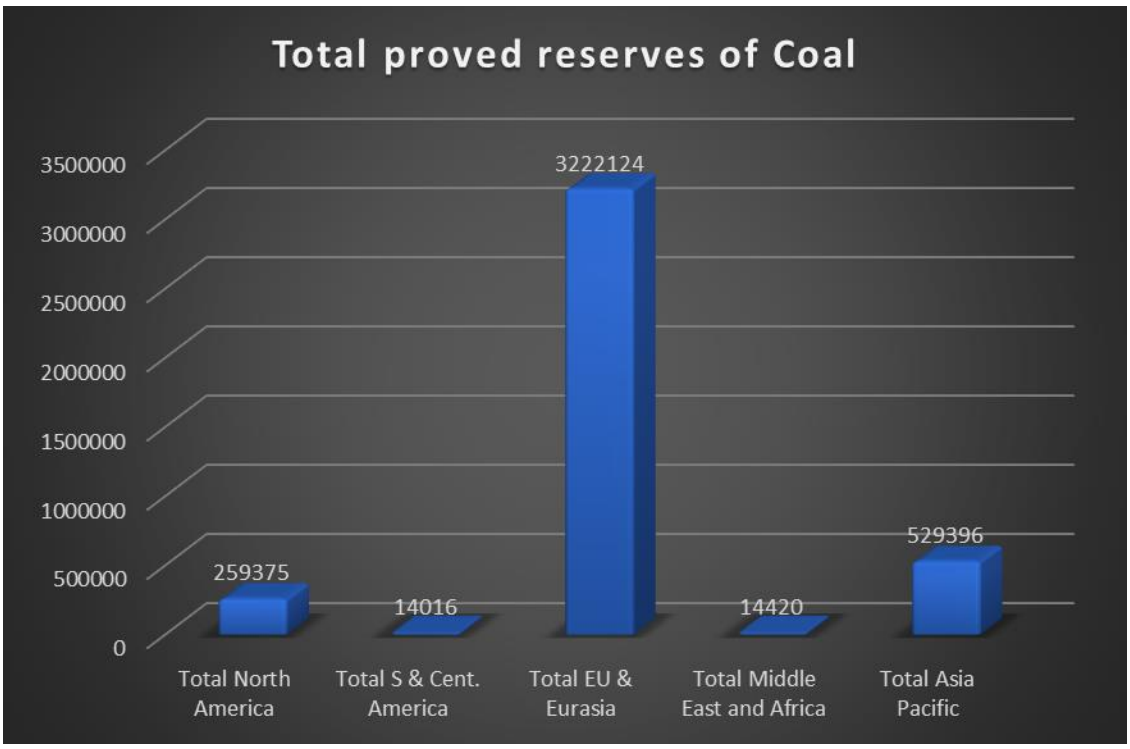
Source: BP Statistical Review of World Energy (2016)

As for coal reserves, according to the World Coal Association (WCA), it is estimated that there are 847 billion tons of "real" coal reserves. This means that with the current production rates, the amount of carbon is enough to meet global needs for the next 118 years. In contrast, the "real" oil and gas stocks offer adequacy approximately 46 and 59

years respectively, with the present production rate. The following figures shows the global distribution of oil, coal and gas reserves by geographic region, China and India.

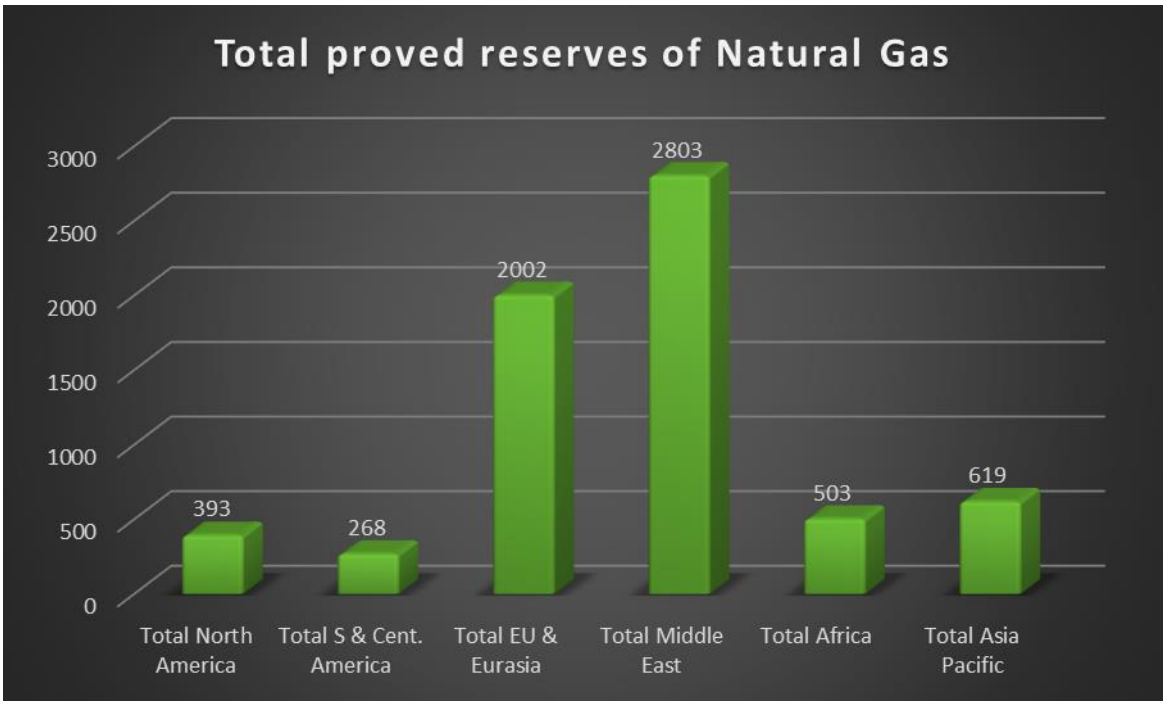
From World Coal Association figures, since 2000 global coal consumption has risen more than any other fuel. The five largest coal consumers - China, USA, India, Russia, Japan - account for 77% of global consumption. The largest coal market is currently Asia, which accounts for 65% of world consumption, in which China is the largest and most important. Many countries worldwide do not have sufficient resources to meet their energy needs and are thus forced to import energy raw materials. For example, Japan, Korea and China Taipei import significant amounts of both steam, for electricity generation, and coking, for the production of steel, coal.

Figure 3.6.2 Total proved reserves of coal in 2016



Source: BP Statistical Review of World Energy (2016)

Figure 3.6.3 Total proved reserves of Natural Gas in 2016 (Trillion Cubic Feet)



Source: BP Statistical Review of World Energy (2016)

Coal is a global industry that is mined in more than 50 countries and used in over 70 other countries. In addition, it is readily available from a wide variety of sources within a well-designed, logistic, global market. Coal can be transported to demand centers via ship or rail. As far as world trade is concerned, coal covers a long way through the sea in order to reach the markets. Over the past 20 years, sea trade in thermal coal has grown annually by 7%, while metallurgical 1.6%. Overall, international trade in coal for 2010 amounted to 1,083 million tons. This figure appears to be extremely large, but it accounts for 16% of the total coal consumed. A fact indicating that the remaining 84% was consumed in the countries where it was granted (internal consumption).

Table 3.6.1 Coal Main Export Countries of 2016

Coal Main Export Countries, 2016 (in mil. Tonnes)		
Country	**2016**	**Percentage**
		%
Total North America	387	10.4%
Total S & Cent. America	35	0.9%
Total EU & Eurasia	462	12.1%
Total Middle East	9	0.2%
Total Africa	95	2.6%
Total Asia Pacific	2753	73.8%

Source: BP Statistical Review of World Energy (2016)

Table 3.6.2 The main coal-producing countries of 2016

The main coal-producing countries, 2016 (in mil. Tonnes)		
Country	**2016**	**Percentage**
		%
Total North America	400	11,00%
Total S & Cent. America	67	1.8%
Total EU & Eurasia	419	11.5%
Total Middle East	1	0.1%
Total Africa	150	4.1%
Total Asia Pacific	2617	71.8%

Source: BP Statistical Review of World Energy (2016)

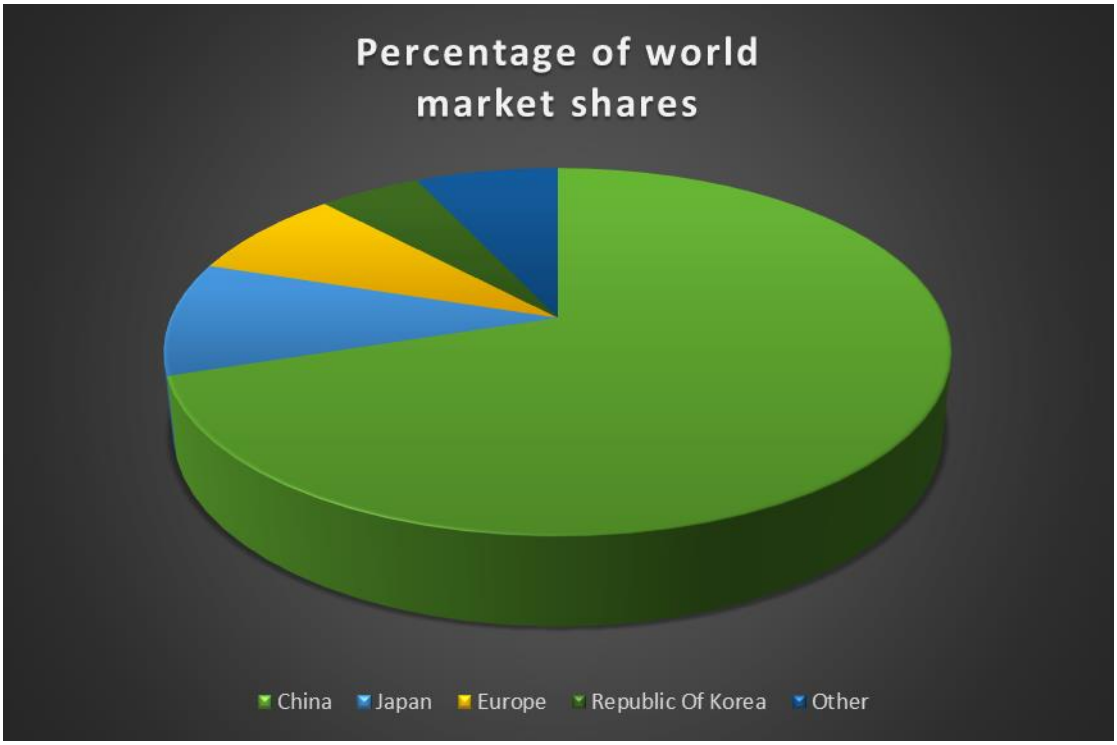
Iron ore

Iron ore trade is the second largest bulk dry cargo trade after the coal trade. Iron ore together with cocking coal is the main raw material for the steel industry. Iron ore includes minerals such as magnet, limonite, iron and calcined iron pyrite. Iron ore along with coal is the two most important bulk dry cargoes traded worldwide (27% and 26% respectively in 2015). Their trade accounts for a total of 53% (in 2015) of the bulk of bulk dry bulk. The main iron ore producing countries are Australia, Brazil, Canada, China, the Federation of Russia, South Africa, Sweden and the United States.

The main iron ore import and export countries (for 2016) are shown in the charts below. Important point to be noted is the fact that Brazil along with Australia, exporting almost 54% of world trade in iron ore. Australia is the main exporter, with 362.4 million

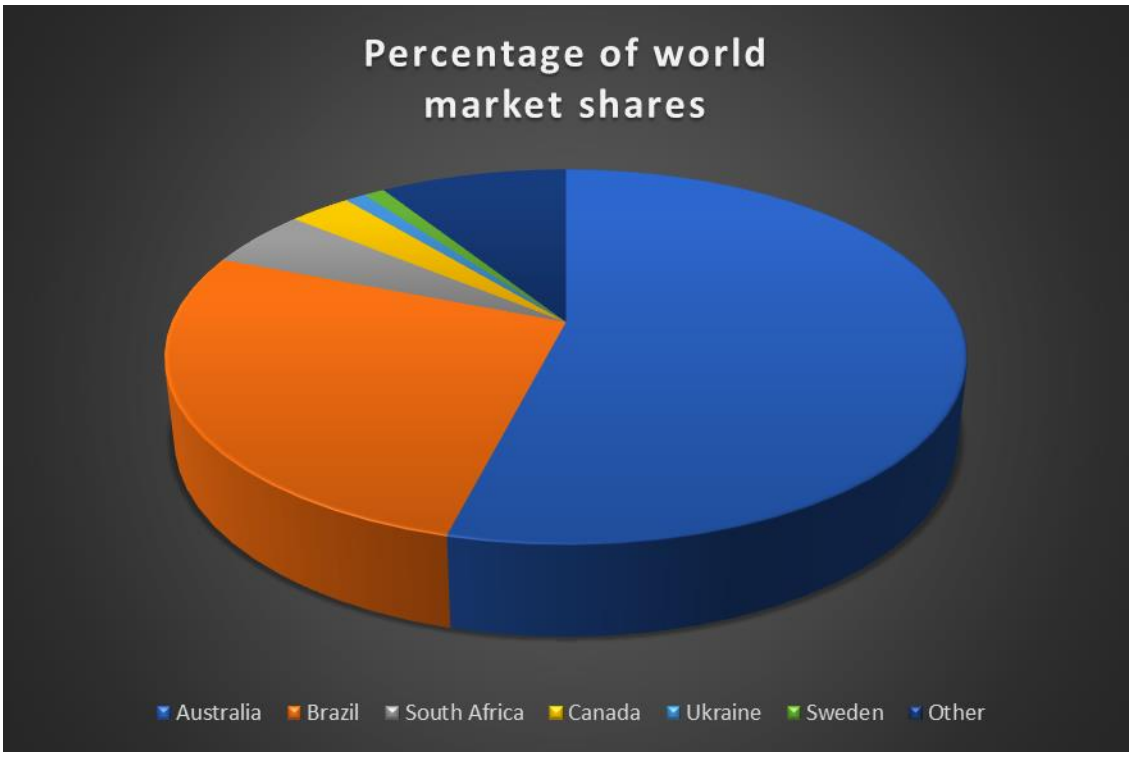
tons of iron ore, and Brazil exported 266.4 million tons (2015). The remaining 20% is exported from countries like Sweden, South Africa, Canada and Ukraine.

Figure 3.6.4 Percentage of Iron Ore Importers for the Year 2015



Source: Review of Maritime Transport (2016)

Figure 3.6.5 Percentage of Iron Ore Exporters for the Year 2015



Source: Review of Maritime Transport (2016)

Grain

It is a large class of cargo, being the main foodstuff in both the developed and the developing world. They are transported in large quantities from the producing countries to the places of consumption, mainly in the autumn months, after harvesting. The quantitative variation and the time period of cereal transport are mainly due to weather conditions prevailing in the producing countries and which greatly affect the amount of annual production.

The term grain, according to the SOLAS International Convention (1974), define: wheat, corn, oats, rye, barley, rice, pulses, seeds, and their processed materials with the same properties as their physical state. Depending on the stacking factor, the cereals are distinguished into hard (wheat, corn, rye and soy) and soft (barley and oats).

Wheat and maize occupy 70% of grain trade. As mentioned, the production and transport of cereals, due to their nature as a commodity and their direct dependence on climatic conditions, their trade (and their transportation) is fluctuating. Because trade is seasonal and strongly changing depending on the crop, the charterers are mainly based on the spot market, using the ships that are available each time. 48% of the world's grain trade is transported by vessels of less than 40,000 dwt, mainly in the range 25,000 - 40,000 dwt and only 6% by vessels over 80,000 dwt. Although economies of scale are being developed in the transport of bulk cereals by sea, a number of factors limit the use of very large vessels, of which the most important are:

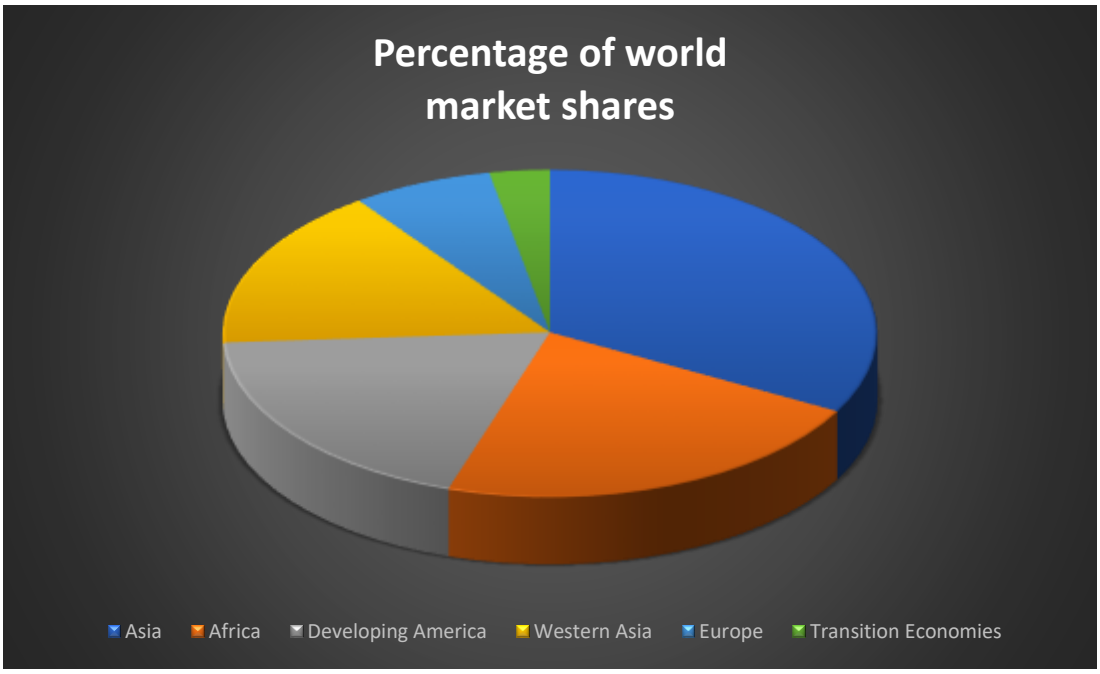
a) Constraints on draft in many grain export ports

b) The occasional nature of cereal trade and the time and quantity fluctuations at the stages of production reflect the specificities of supply and demand. This uncertainty deviates from the generalist standardization of world trade, making it difficult to plan for the use of large vessels

c) The complex structure of the market.

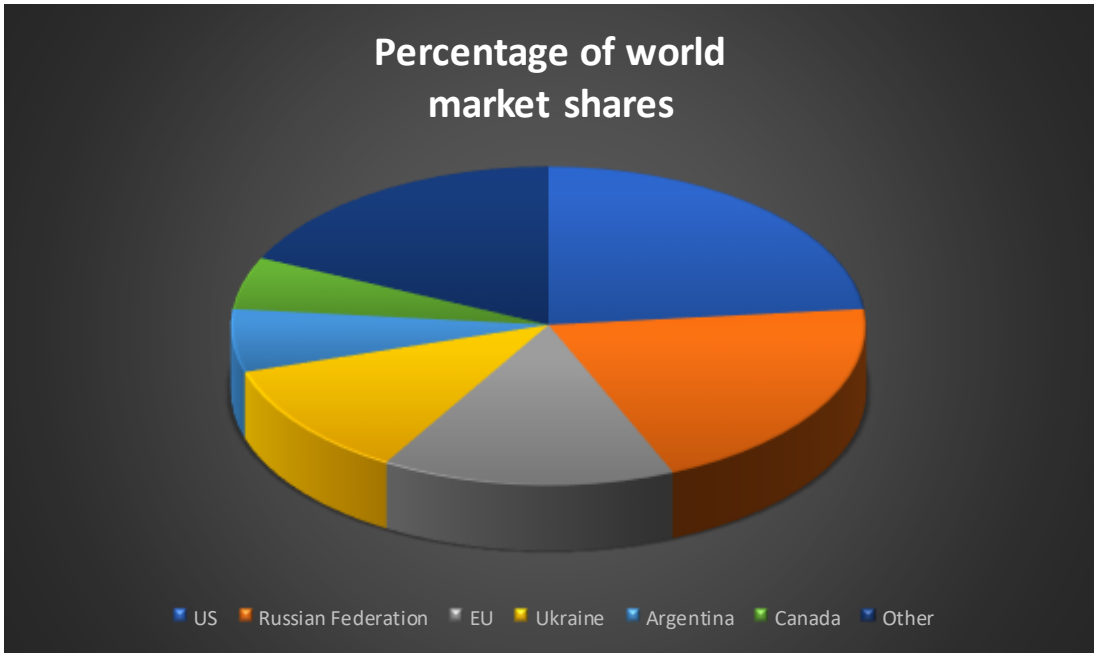
Major exporters of cereals are the USA, Canada, Argentina, Australia, France, Ukraine and Russia. While major importers are Japan, Eastern Europe, Russia, Western Europe, North Africa and others. The following figure shows the main cereal exporting and importing countries for 2015-2016.

Figure 3.6.6 Percentage of Grain Exporters for the Year 2015



Source: International Grain Council (2016)

Figure 3.6.9 Percentage of Grain Importers for the Year2015



Source: International Grain Council (2016)

Bauxite – Alumina

Bauxite is a mineral ore containing aluminum oxide. Through the processing of the alumina resulting aluminum. After the iron, aluminum is the second most widely used metal in the world. Its production is constantly increasing, as more and more uses are being developed for this particular metal. The trend that has existed in recent years is the processing of bauxite into alumina at the source, which limits the transport requirements at this stage of production. This is also apparent in the main productive countries of both bauxite and alumina, where production is identified in the same country to a large extent.

Major producers of Bauxite: Australia (40% of the world total), Brazil, Ghana, Greece (the largest bauxite producer in Europe and 12th in the world accounting for 2% of the world's output), Guinea, Guyana, India, Jamaica, Suriname, the US. Main producers of Alumina: Australia, Brazil, Canada, China (the 3rd largest producer), USA (2nd largest producer), Guinea, India, Iran, Ireland, Jamaica, Russia, Spain, Suriname, Ukraine, Venezuela.

Generally speaking, the main exporters of bauxite and alumina are Australia, West Africa, Jamaica, Central and South America. The sea trade of bauxite and alumina follows a similar structure to that of iron ore and coal but with some specific characteristics.

Trade in alumina does not favor the use of Panamax (60,000 - 85,000 dwt) or larger, as alumina is a product of great economic value (as opposed to coal and iron ore) and the quantities of raw material required by an aluminum-producing plant are too small to encourage large bulk shipments. Most of the ports handling these loads belong to the aluminum industries themselves.

Phosphate

Phosphates are used to produce fertilizers. More specifically, they are the main raw material for the fertilizer industry and the most important commodity in fertilizer trade. The main exporters are Morocco, the US, Russia, Africa and some of the Pacific Islands. The main importing countries are Western Europe, Japan, Central and South America. There is no demand for large quantities and so large vessels are not used. More specifically, 38% of the sea trade is covered by vessels of less than 18,000 dwt, 15% by vessels of 18,000 - 25,000 dwt, 31% by vessels of 25,000 - 40,000 dwt and 16% by vessels above 40,000 dwt [8]. In addition, the majority of the phosphate landing ports cannot accommodate ships over 50,000 dwt.

3.7 GENERAL ASPECTS OF DRY BULK MARKET

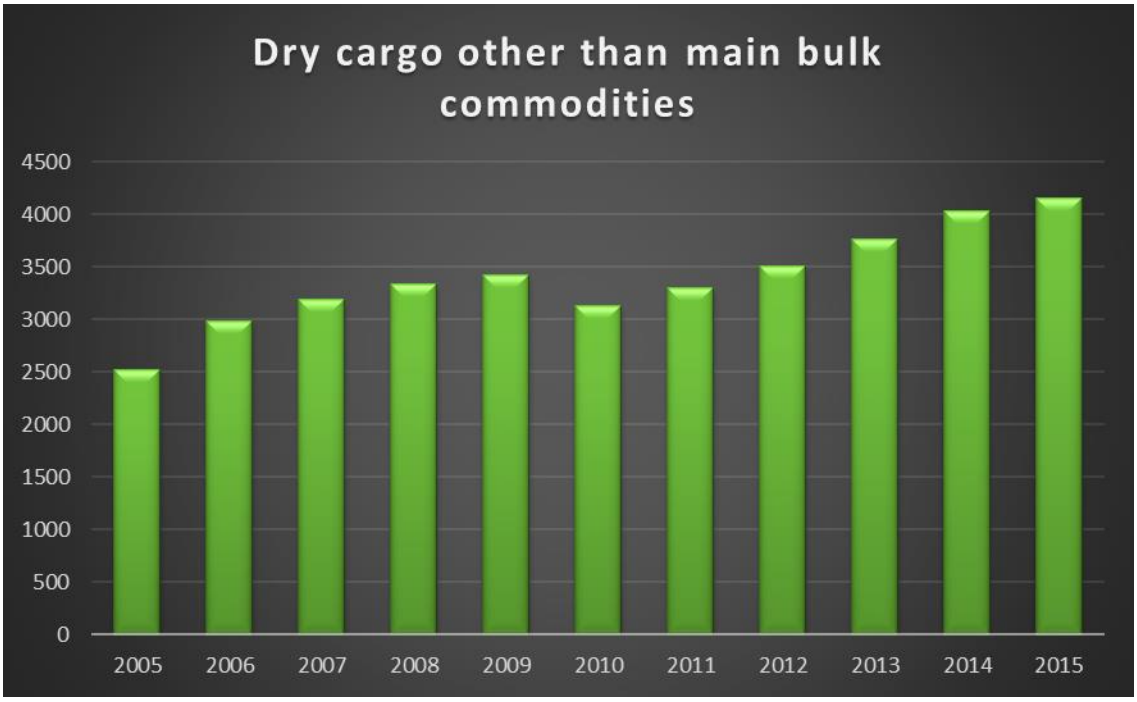
Trade in dry bulk cargoes affected, of course, directly on the demand for these very dry bulk goods, which in turn is connected with global economic activity. In general, the change in GDP and industrial production is directly related to the change in demand for tonnage for shipping, which is reflected in the study of cycles (economic, commercial, shipping). The graph below shows the change in world dry bulk trade between 2005 and 2015.

Figure 3.7.1 Schematic representation of demand pattern in bulk dry bulk shipping.

Source: Stopford (2013)

At a general level, there is a direct correlation between the global economy and international shipping. Both the correlation and the value of it change over time. For example, China's entry into the World Trade Organization (WTO) in 2001 and its large-scale industrial development have led to both global economic stimulus and increased maritime trade.

Figure 3.7.*2 Developments in international seaborne trade of main bulk commodities, selected years 2005-2015 (Millions of tons loaded)*



Source: Review of Maritime Transport (2016)

According to "The Platou Report 2011", between 2003 and 2010, 80% of the annual change in capacity demand can be attributed to the change in global economic growth, while the remaining 20% is due to factors unrelated to economic growth. These may be extreme weather conditions, strikes, non-cyclical fluctuations in stocks of goods and corridor changes to avoid piracy. Factors that are perceived as difficult to predict.

Continuing on the general level of merchant shipping, it can be said that the forecast of capacity demand is part of its correlation with global economic growth. A simplified assumption, in terms of forecasting demand for tonnage in the shipping sector, is as follows:

The change of one percentage point of GDP corresponds to a change of two percentage points in the demand for capacity of the world merchant fleet. Of course, this generalized assumption cannot be applied to every sector - commercial shipping category, but in a general context it can be used as a preliminary and simplified prediction tool. Returning to the market and shipping of bulk dry loads, in history, specific economies have

been the leading forces in the bulk shipment of bulk cargo. For example, in the 1990s, Japan was the main economic power that spurred the growth of maritime transport marches as booming industrial production tightened demand for bulk dry goods.

Over the last decade, China and, to a lesser extent, India, have become the leading economies to boost the bulk trade in dry goods, as their strong economic growth generates demand for raw materials imports. The table below shows the change in GDP of China and India in relation to the change in world GDP and the change in GDP of the US, the European Union and Japan.

Table 3.7.1 Real GDP Growth. Annual Percentage Change

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
World Economy	**5,5**	**5,6**	**2**	**-0,1**	**5,4**	**4,2**	**3,5**	**3,4**	**3,5**	**3,4**	**3,1**
US	**2,7**	**1,8**	**-0,3**	**-2,8**	**2,5**	**1,6**	**2,2**	**1,7**	**2,4**	**2,6**	**1,6**
EU	**4,3**	**4,2**	**1,5**	**-4,9**	**2,5**	**2,2**	**0,3**	**0,5**	**1,4**	**1,3**	**1,6**
Japan	**1,4**	**1,7**	**-1,1**	**-5,4**	**4,2**	**-0,1**	**1,5**	**2**	**0,3**	**1,2**	**1**
China	**5,5**	**5,6**	**3**	**0,1**	**5,4**	**4,2**	**3,5**	**3,4**	**3,5**	**3,4**	**3,1**
India	**9,3**	**9,8**	**3,9**	**8,5**	**10,3**	**6,6**	**5,5**	**6,5**	**7,2**	**7,9**	**6,8**

Source: World Economic Outlook (2017)

The large annual change as well as its fluctuation in 2008 and the years following the crisis is noticeable. Especially in 2009 where for all other countries a negative sign of change occurred, for India and China it fell to some extent but remained positive.

4.1 INTRODUCTION

Bunker fuel can be simply defined as ships' fuel. Fuel itself can be very important in a number of contexts, such as 'in time charters, voyage charters, and liner contracts' (Brodie, 2006, pg 76). When a vessel is nominated for a time charter, the owner calculates the bunkers which will be on board, and agrees on a price he will be paid for these. In the case of re-delivery when the charter has ended, the same exercise will take place, but this time the charterer will be the one being compensated for the remaining bunkers (Brodie, 2006, pg 76).

To continue, when a vessel is fixed under a time charter, the charterer has the options of choosing where to bunker the vessel, which bunkering service he will use, and what quantities to take onboard if he so requires, bearing in mind requirements such as the level of bunkers to leave remaining onboard upon re-delivery and the geography of the voyage to be undertaken (Brodie, 2006, pg 76).

For voyage charters, the responsibility of paying for bunkers lies upon the ship owner. However, charter-parties may include clauses relating to bunkers, such as the bunker deviation clause, and the bunker escalation clause. The bunker deviation clause allows the charterer to deviate from the agreed route in order to bunker the vessel. Furthermore, the bunker escalation clause simply states that 'if a higher price is paid during the contracted voyage, the ship-owner is to be reimbursed by the charterer for the extra cost' (Brodie, 2006, pg 77).

Arranging to bunker a vessel is a task that should not be taken lightly, as 'a lack of skill and attention could have adverse effects ranging from mere loss of profit to severe damage to the machinery even total disaster' (ICS, 2009, pg 92).

Bunkering can be classed in three sub-headings, these being the quantity, the quality, and the cost (ICS, 2009, pg 92). Keeping this in mind, each factor is analyzed in order to provide the groundwork for the major importance bunkers have in the voyage costs of vessels.

4.2 THE QUANTITY

Fuel oil is of great importance to the shipping industry. The prime movers of the merchant vessels will consume fossil fuel; until the day it will cease to exist. Bunkers make up the largest part of a ship's running costs, and always have done. It is estimated that their cost comprises a percentage of 50-60% of the total running costs, i.e. daily running costs and voyage costs.

When focusing on the quantity of bunkers at hand, the first task is for the operations' department to 'explain the itinerary of the next voyage(s)' (ICS, 2009, pg 93). The amount of bunkers onboard will be known, and through performing voyage estimations the days of steaming and port time for the concerned voyages will be established (ICS, 2009, pg 93).

Further on, the quantity will directly depend on the geography of the specific voyage, and whether or not suitable bunkering ports coincide with the itinerary. With respect to this, the route of the voyage may need be adjusted, or a bunker deviation clause adhered to, in order for the optimum bunkering port to be chosen, with optimization being achieved by obtaining the necessary quantity of bunkers at the necessary quality for the engines to operate efficiently, at an acceptable price. Geographically, it can be remembered that crude oil refineries, which refine oil to the point it can be used, lie near the areas where oil is consumed, not produced (ICS, 2009, pg 93).

As a result of this, keenest prices can be expected at ports, such as Rotterdam, New York, Rio de Janeiro, and Cape Town, as these are cities with high populations, and as a result high fuel consumption (ICS, 2009, pg 93). It should be noted that ports established as bunkering ports, such as Singapore and Gibraltar, may be so due to having a strategic position with relation to many voyage routes (ICS, 2009, pg. 93).

Many vessels nowadays perform voyages on the same routes due to specialization, however in the dry bulk industry 'tramp' shipping is usually involved with the carriage of cargoes, so 'first-time voyages may occur often and this is the stage that demands bunkering expertise' (ICS, 2009, pg 93). As a result of this 'tramp' nature of bulk shipping, many factors must be taken into consideration when bunkering. Initially, one more ton of bunker fuel translates to taking one less ton of cargo onboard. Consequently, bunkering more than the required amount for a voyage when a cheaper price can be achieved in addition with the port disbursements involved and the time spent deviating from a voyage if

this is the case, has to balance against the additional freight revenue that could be earned by the vessel by taking on more cargo and fewer bunkers (ICS, 2009, pg. 93).

Finally, quantity is also vital in the simple sense that a vessel should not risk falling short on bunkers as this could result in a salvage requirement, or even a loss of crew or total loss of the vessel. For this reason, a safety factor should also be calculated within a vessel's bunkering program, which will 'usually take into account the distance during that voyage sector from an alternative bunkering port' (ICS, 2009, pg 93).

4.3 THE QUALITY

Marine fuel oil consists largely of a residue that remains from crude oil distillation after stripping off all components of lower boiling ranges. It consists of a great variety of long chain hydrocarbons in a boiling range predominantly well above that of gas oil. As crude oil varies widely in composition and quality, so does the residue.

In particular, there are crude oils of high and low viscosity, high and low sulfur content, etc. This results in varying yields of residues suitable for producing marine fuel oil.

Furthermore, a refiner for economic reasons is interested to extract as many high value fractions from the crude oil. "A modem refinery of sophisticated design is operated to affect precisely this. Little or even no residue at all is left today. The consequence is that these residues contain most components and contaminants of the crude oil undesired in the high value products in a high concentration. Inevitably, therefore, the last 30 years of 'upgrading' refineries have resulted in a corresponding downgrading of residues and in consequence marine fuel oil quality. (Fleishchhack and Rulfs, 1997).

The quality of a fuel has an effect on:

- The combustion process
- The exhaust valves
- The inlet valves and pumps
- The turbochargers and exhaust gas system
- The handling of the fuel

- The fuel treatment process

Quality Parameters

- Density (kg/m3
- Viscosity (cSt)
- Pour Point and Cloud Point ("C)
- Flash Point ("C)
- Carbon Residue (% m/m)
- Asphaltenes (mg/kg)
- Ash Content (% m/m) - Al/Si (mg/kg) - Vanadium (mg/kg)
- Water and Sea Water (% v/v)
- Sulphur (% m/m)
- Compatibility and Stability
- Ignition Quality

Information on each of the above quality parameters is not mentioned in the thesis, since it is not the purpose of this project to establish basic knowledge on fuels. It is important to know though in what way will each of these affect the onboard usage of the fuel. However, it is important to refer to the basic type of oil the ship's machinery is designed to consume and at the oil's viscosity.

4.3.1 The Type of Oil Consumed

As bulk carriers are equipped with diesel engines, the two main types of fuel modern vessels consume are Intermediate Fuel Oil (IFO), and Marine Diesel Oil (MDO). IFO is called Intermediate, because Heavy Fuel Oil (HFO) is that 'which is burnt in oil-

fired furnaces and some very large diesel engines' (ICS, 2009, pg 94). IFO is consumed for the main engines and generators, while different vessels will need different grades of IFO. MDO is consumed for the auxiliary engines. It is essential for IFO to undergo treatment onboard the vessel, as some residues must be removed before consumption, even though some residues are inherent in the oil (ICS, 2009, pg 94).

If the content of remaining inherent fuels in the oil such as sulfur is too high, corrosion can be caused due to the formation of acids. Other inherent fuels such as sodium and vanadium may cause damage to the engine's exhaust valves.

Besides the need for bunker fuel to be filtered by a vessel's engine room equipment, the engines are designed to cope with a certain quality of bunkers, while the fuel itself must be heated so it flows through the injectors with ease (ICS, 2009, pg 94)

4.3.2 The Oil's Viscosity

Viscosity can be described as 'an oil's reluctance to flow freely' (ICS, 2009, pg 94) and all bunker fuels are classed based on this in a unit known as Centistokes (cST). When referring to viscosity it is vital to add the temperature the figure is based on. The temperature used upon ordering bunkers is 50 ^{o}C, and the quality is usually based on the ISO 8217 quality standard. ISO 8217 deals with the acceptable limits of fuel impurities such as ash, vanadium, aluminum, silicon, and Sulphur (ICS, 2009, pg 94). Furthermore, the above ISO standard is based on a 100 ^{o}C temperature, but tests are carried out at 80 ^{o}C, and extrapolated to 50 and 100 degrees Celsius respectively (ICS, 2009, pg 94). 180 CST at 50 ^{o}C equates to 25 cST at 100 ^{o}C.

In order to ensure that the fuel is of the agreed quality, a sample is always taken on the time of the fuel's delivery. A way of double-checking that the bunkers supplied are of the agreed quality, ship owners also may use independent quality analysis services, the best known being:

Lloyds Register – FOSBAS (Fuel Oil Bunker Analysis and Advisory Service

Norske Veritas – VFQT (Veritas Fuel Oil Quality Testing)

(ICS, 2009, pg 78).

4.3.3 The Importance of Stating a Quality Standard in a Time Charter

In a time-charter, the charterer will look to economize on fuel consumption as much as possible, and in some cases he may use a different and possibly cheaper quality of fuel, which may have a long-term damaging effect on a vessel's engines. For this reason, a bunkers standard must be set.

Another important reason to use the appropriate bunkers is the fact that 'a poor fuel will give poor speed/consumption figures and this is the most fruitful area for time charter disputes without adding the effects of bad fuel to the debate' (ICS, 2009, pg 95).

4.4 THE PRICE AND COST

The price of bunkers and the vessel's consumptions are vital when a prospective time charterer examines voyages and compares suitable vessels (Brodie, 2006, pg 76). Furthermore, fuel cost fluctuations have 'naturally influenced the whole state of voyage costs, as bunkering is by far and away the most important element in the operation of a vessel' (Rowbotham, 2008, pg 135).

In order to choose the optimum bunkers for a vessel, one must obtain the best quality of bunkers, at the lowest possible price. Additionally, another way to save money on bunkers is by imposing a bunker adjustment factor.

4.4.1 The Bunker Adjustment Factor

The bunker adjustment factor mainly applies to voyage charters, and was originally created in 1974 after the need for providing a bunker surcharge arose since oil prices quadrupled, and fuel became a significant element of the costs incurred by the ship-owners (Brodie, 2006, pg 74). As owners may be vulnerable to rising bunker prices when chartering a vessel for consecutive voyages, the BAF acts as a surcharge in order for the shipowners to hedge the increase in fuel costs. The BAF is activated by what is known as a trigger point, and this can occur by a high percentage change in the price, where the owner may want to share the costs of high bunker prices.

4.5 SUMMARY

To sum up, it can be safely argued that regarding vessel bunkering, quantity, quality and cost must be carefully balanced out in order to provide the optimum result. More particularly, when a vessel is employed under a time charter, it is imperative that the owner always carefully specifies the bunker quality to avoid damage to the engines. It must be also identified that bunkering can greatly contribute to poor speed/consumption figures for a vessel as stated earlier, resulting in a direct link between bunkering and a vessel's economic efficiency.

5 RESEARCH METHODOLOGY

5.1 INTRODUCTION

The main purpose of this chapter is to introduce some important fundamental concepts of the type of research used to readers. It comprises types of research, definitions of qualitative research, different types and assumptions of qualitative research, when to use and not to use qualitative methods, advantages, common approaches and samples of quantitative research, and common misconceptions. Besides, a set of criteria for evaluating qualitative research proposal is provided. The main focus is on the assumptions underlying the qualitative research and some of the misconceptions that many researchers have when they are conducting a research study.

The methods option allowed to systematize the data and to increase transparency without being constructed by rigid procedures. The literature review constituted an extensive process of discerning the most relevant materials addressing the topic. The potentiality of the literature to associate to the discussion on the subject matters and to the findings conferred assurance towards the possibility to contribute to the stock of knowledge.

5.2 RESEARCH METHOD

The author has deemed the qualitative approach as being the most suitable method for this research. Qualitative strategy is defined as an approach that emphasizes words rather than quantification in the collection and analysis of data (Bryman, 2012).

In conjunction with qualitative studies, Denzin and Lincoln (2000) affirm that there are various academic and disciplinary resistances, as the emphasis in a study as such is placed on the qualities of entities and on processes and meanings that are not experimentally examined or measured.

The first part of the research will be desk research and will mainly be qualitative research. This includes studying the literature, observation and online research.

The second part of the research will mainly be field research, but there will also be some desk research. For field research companies will be contacted in different ways, this will be qualitative and quantitative. Contacted companies will be providers of the insulation. Every sub question needs a unique approach for researching. There will be interviews, group discussions, face-to-face research and observations. Several semi-

structured interviews have been conducted with purposively selected candidates. Analysis of data presupposed primary data, inductive reasoning based on interviews, qualitative content analysis, secondary data and own observations.

5.3 RESEARCH DESIGN

A research design provides a framework for the collection and analysis of data (Bryman, 2012). It reflects the decisions the author has taken in relation to the priorities accorded to a range of dimensions in the research process. It presupposes the expression of causal connections between variables and understanding behaviors and their meanings within a specific context. But, also allows for a temporal assessment of phenomena and their interconnections (Bryman, 2012).

The first phase of this study was to collect secondary data, leading to the settlement of theoretical framework. This part has been confronted with the abstractness of grand theories operating at a more general level (Merton, 1967) and which necessitated the inference of middle range theories in order to connect to the reality. Primary data from the interviews provided for new perspectives and determined further grounds to extend the theoretical framework. The exploratory nature of the thesis has emerged incontestable at this stage.

Second step consisted of collecting information by interviewing the candidates. The exploratory strategy fairly prescribed for semi-structured interviewing as to allow for considerable leeway. Nevertheless, an interview guide has been utilized to ensure a proper coverage of inquiries (Bryman, 2012). The author has perceived each interview as a particular case study in order to further conduct a comparative cross-case analysis.

The rationale behind it implies the very logic of comparison and precisely that it’s easier to understand phenomena when more contrasting cases are being compared (Bryman and Bell, 2011). The cross-sectional design format acts as a springboard for theoretical reflections upon contrasting findings, as well (Bryman, 2012).

5.4 LIMITATIONS OF THE STUDY

For the completion of the thesis the author used types of qualitative research such as observations, interviews, case studies and content analysis. Quantitative analysis involves

experiments, surveys and other measurable data. However, the small sample size typical of qualitative studies limits generalizations and external validity of the findings; this might limit the scope of the research as it is difficult to assess the impact the research has on real world situations. It also takes more time to gather qualitative data. Interviews and focus groups take hours to produce results. Qualitative research was used to identify the factors that affect the areas under investigation, and then use that information to devise quantitative research that assesses how these factors would affect user preferences. Finally, the quality of research is heavily dependent on the skills of the researcher and can be easily influenced by personal idiosyncrasies and biases of researchers.

For the purpose of this study a quantitative research was used where numerical secondary data collected in order to support supply and demand patterns in dry bulk shipping and its effect on fuel cost and consumption, examining the voyage costs of vessels for optimum economic efficiency, and the several reasons that cause fluctuations in stakeholders' confidence. The Quantitative methods that author used, although summarized vast sources of data, however may reflect the view of the researcher rather than those of the respondent. The findings of quantitative research methods may lack a detailed narrative of human perception.

6.1 INTRODUCTION

The marine fuels industry is characterized by a complex, international network of organizational and trade relationships. The significance of the fuel consumption of dry bulk cargo vessels has increased of the years in the dry bulk industry, as vessel revenues have dropped sharply due to a number of factors, the primary being vessel oversupply in the market.

Fuel utilized by shipping companies for fuelling their marine fleet is commonly referred to as bunker fuel. Currently, fuel oil is the most widely used bunker fuel. However, apart from fuel oil, other middle distillate fuels are also utilized as bunker fuels. Bunker fuel costs account for approximately 70% of the total voyage expenditure for a vessel and ship operators prefer purchasing bunker fuel from ports where the cost is lower. Some operators prefer purchasing a major portion of the total fuel requirement for the voyage from a single port which offers bunker fuel at economical prices. However, this is not an industry-wide scenario as other operators may spread the total fuel purchase over numerous ports.

The results of interviews with experts suggest that increased fuel costs will, in time, be incorporated in their entirety in sea freight costs, which means that sea freight costs will increase considerably when the tighter regulations on sulfur content take effect in last years. Marine distillates historically come from poorer-quality distillate recycle streams that are unsuitable for upgrading to diesel fuel or other low-sulfur products.

Rising freight costs will particularly affect export- and/or import-oriented sectors, such as the metal and forest industries. In addition, the stringent sulfur emission standards, especially in Emission Control Areas (ECA), have gradually led shipping companies to adopt clean fuel grades. The middle distillate and low sulfur fuels are now being traded in all major ports of the world. Though marine fuel is traded at almost all ports around the world, a major volume of the overall trading activities are concentrated among a select number of ports. Ports that are strategically located along major transit routes have emerged as prime bunkering destinations. The Port of Singapore and Fujairah are large bunkering ports, which account for a significant share of the overall bunker fuel traded in the global market.

6.2. FINDINGS

Most of the worldwide bunker fuel consumption trends affect a vessel's employability to a substantial level, even more when hire rates drop, as cost minimization is sought by methods, such as slow steaming. Given the fact that the current market conditions are looking low-spirited, as growth is expected to be smaller than in previous years is apparent that fuel consumption becomes a vital indicator of economic performance of a dry bulk vessel, with the magnitude of fuel consumption as an employability indicator increasing as the dry bulk market falters.

In the bunker industry, there are two primary kinds of fuels currently being used; distillate fuel and residual fuel. Among the two, residual fuel accounted for around 75% of global bunker consumption in 2013. The residual fuel oil segment comprises intermediate fuel oils (IFOs), among which IFO 380 and IFO 180 are the most preferred fuel grades. The IFO 380 fuel grade is relatively inexpensive compared to other bunker fuel grades, which are freely traded in the market. With majority of ship engines capable of combusting IFO 380, it is currently the most popular fuel grade in the bunker market. The IFO 380 grade is likely to exhibit moderate growth rates in demand during the forecast period.

Currently, bulk and general cargo vessels account for a significant share of the overall bunker consumption. Cargo vessels generally require more time and manpower to carry out loading and unloading activities as compared to container vessels. As a result, container vessels are gradually substituting general cargo vessels in the global trade scenario. Owing to this substitution effect, general cargo vessels are likely to moderately lose out on market share to container vessels with respect to bunker consumption globally. Container vessels are likely to be the most attractive market segment for bunker consumption during the forecast period. Owing to the simplified loading and unloading procedures applicable for these vessels, they are being increasingly preferred over cargo vessels in major ports across the world. Tanker vessels also account for significant market share globally in terms of bunker fuel consumption. Major crude oil consumption and production canters such as Asia Pacific and the Middle East are expected to register a continuous increase in tanker trade throughout the following years.

Asia Pacific is the most prominent market for the bunker fuel industry. The major commodity consumption centres in the world currently lie in the Asia Pacific region. The Singapore Port in Asia Pacific is currently the largest port in the world in terms of volumes of bunker fuel traded. Europe is welcoming to some of the busiest trading routes in the world, which have been evolved into major trading routes and as a result, large bunkering ports have been developed across the region. Busy ports such as the Port of Rotterdam and the Port of Gibraltar have been developed as highly attractive bunkering destinations owing to their presence.

Currently, bunker fuel is supplied in the global market by three seller categories: major oil companies, large independent bunker suppliers, and small independent bunker suppliers. Companies such as Chemoil Energy Limited and World Fuel Services Corporation offer bunkering services in all major ports of the world. On the other hand, companies such as Lukoil-Bunker LLC operate only in restricted regions. Leading independent distributors that own physical assets such as storage terminals and blending facilities in major bunkering ports have additional advantage over small independent distributors. The financially stable large distributors are in a better position to acquire these physical assets in large ports as compared to smaller distributors. With increasing demand for bunker fuel from developing regions of Asia Pacific, bunker supplying companies are expected to expand their operations in major ports of this region.

On the other hand, employability remains higher for vessels, which could be considered as ‘market leaders’ in terms of low fuel consumption. Additionally, even though the market is historically expected to bounce back, market fundamentals indicate that the current shipping cycle will not perceive yet high freight/hire levels.

Moreover, as bunker prices are at high levels, vessel employability for high bunker-consuming vessels is bound to remain at distressingly low levels, making fuel-hungry vessels the prime candidates for exiting the market through either being laid-up or headed to the scrapyard in order to finally rid the market of the excess tonnage that keeps on surpassing demand.

Dry bulk shipping is still undergoing difficult times and the key stakeholders within the industry can be attributed with an almost self-inflicting tendency to ignore the simple

principles of demand and supply for the sake of asset-play and buying cheap vessels in hope that will reduce the tonnage supply. The belief that investors, who acquire vessels, will lead the market and employ their vessels is still substantially risky, as the current market still takes longer to significantly pick up.

In effect, this is a problem, as shipowners must either cut or slow down supply to levels where the bulk fleet only slightly surpasses the demand for sea transport, as the past has shown that where this has happened, there was room for huge profits to be made. In any other case, the market will rely on and demand for commodities and products increasing, putting the fate of the market out of the hands of the stakeholders. As these bold moves of the market are present to be seen, it can be said that the ones that really control the market are the stakeholders that go against the market sentiment at all times, and until the number of this type of market speculators and vessel owners increases substantially, the only answer to securing acceptable employability for a vessel in comparison to the competition, lies now more than ever before in its fuel efficiency.

6.3 CONCLUSIONS

It is stated that demand for marine fuel will continue to grow. The drivers of total demands for each fuel are the combination of the evolving fuel mix, the evolving transport demand and the evolving fleet's energy efficiency. However, fuel demand will start decreasing despite having the highest transport demand, and that's because mainly of its energy efficiency improvements.

The bunker market is changing and maybe this is a genuine restructuring. Liquefied natural gas (LNG) is likely to become the marine fuel of the future. Stakeholders in the commercial-shipping industry probe when LNG will become the dominant bunker as this tendency is critical to planning and executing investment decisions that will amount to hundreds of billions of dollars' industry-wide in the forthcoming years.

Ship owners and operators must forecast the adoption of LNG as they continue to confront challenging times. For years, the shipping industry's performance has been weighed down by the twin burdens of plunging freight rates and increasing bunker costs, and a full recovery is not in prospect.

Beyond economics, environmental considerations argue against a complacent attitude toward bunker. Executives rejoicing in low crude-oil prices may be tempted to take a wait-and-see approach regarding investments in LNG and other low-sulfur fuels. But even in the near term, delaying the adoption of cleaner fuels will mean that large cargo ships will continue making an outsized contribution to carbon dioxide emissions globally. Administrators who are committed to transitioning to a "green" shipping industry will stay focused on the environmental advantages of burning cleaner fuel.

Respected regulators such as the International Maritime Organization (IMO) are forcing the industry and playing a critical role in determining the optimal time line for shifting to LNG. The growing number of IMO Emission Control Areas (ECAs) has already forced shipping companies to shift a greater share of their fuel consumption to low-sulfur fuel, even if it is more expensive but environmentally friendlier. Vessels operating in ECAs must abide by stricter sulfur-emissions regulations.

The International Maritime Organization (IMO) announced that plans to apply a global cap on sulfur emissions as of 2020 rather than the proposed delayed date of 2025; the review will be concluded in 2018. The uncertainty about when the cap becomes effective has added to the complexity of deciding when to switch to LNG. Possibly one of this year's most challenging 2020 conversation points will be about the enforcing of the new laws. Most industry players seem to be on board with these forecasts and are taking a wait-and-see attitude toward investing in either HFO scrubbers or LNG-fueled engines. Although the timing for LNG's anticipated widespread adoption remains uncertain, the first LNG engines in container vessels will soon be in more operation.

To conclude, 2016 was a tough year for shipping managers and while there is optimist for improving conditions in shipping markets, 2017 nevertheless seems to be another difficult year. Last year started with dry bulk rates at historic lows, the collapse of Hanjin which underlined the fragility of the box sector, the bunker prices having doubled over the course of the last year with shipowners facing increasing fuel costs, and even the tanker market which were booming when oil prices were rock bottom, 2017 does not seem a prosperous year.

On the other hand, in 2017, has already been historical for the industry as Singapore, the world's biggest bunkering port by volume, as from 1st January requires the use of a mass flow meter (MFM) for MFO bunkering, the first port in the world to do so. Finally, the attraction of digitalizing the bunker process in terms of cost savings has already start up by Port Authorities and bunker industry players showcasing their E-Ship Safety, E-Stem and E-BDN modules. Therefore, industry managers will hold more challenges in various forms throughout this year and beyond.

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